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IN THE

Supreme Court of the United States

OCTOBER TERM, 1969.

No. 338

BLONDER-TONGUE LABORATORIES, INC.,
Defendant and Counter Claimant-Appellant-Petitioner,

vs.

UNIVERSITY OF ILLINOIS FOUNDATION,
Plaintiff and Counterclaim Defendant-Appellee,

AND

JFD ELECTRONICS CORPORATION,
Counterclaim-Defendant-Appellee, Respondents.

PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE SEVENTH CIRCUIT.

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BLONDER-TONGUE LABORATORIES, INC.,
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vs.

UNIVERSITY OF ILLINOIS FOUNDATION,
Plaintiff and Counterclaim Defendant-Appellee,

AND

JFD ELECTRONICS CORPORATION,
Counterclaim-Defendant-Appellee, Respondents.

PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE SEVENTH CIRCUIT.

To the Honorable Chief Justice and Associate Justices of the Supreme Court of the United States:

Your petitioner, Blonder-Tongue Laboratories, Inc. (Defendant and Counterclaimant-Appellant below), hereby petitions that a Writ of Certiorari issue to review the judgment of the United States Court of Appeals for the Seventh Circuit in the above action dated February 13, 1970, rehearing denied April 2, 1970, affirming the decision

of the United States District Court for the Northern District of Illinois, Eastern Division.

A certified transcript of the record in the above case, including the printed Appendix to Brief for Defendant and Counterclaimant-Appellant and the proceedings in said Court of Appeals, is furnished herewith. References to the printed Appendix will be designated by App. and the page number.

OPINIONS BELOW.

The opinion of the Court of Appeals for the Seventh Circuit is reported at 422 F. 2d 769 (1970) and appears as Appendix A (A1-A18) to this petition and in the certified transcript. (A minor modification of that decision on petitioner's request for rehearing is included.) In this opinion, Isbell patent 3,210,767 was found valid. The decision of the District Court, Northern District of Illinois, Eastern Division, is not reported. It is reproduced in the record, App. 820, and as Appendix B hereof (A19-A40).

The judgment of the Court of Appeals for the Seventh Circuit was entered on February 13, 1970, and the modified judgment, on a timely petition for rehearing, was entered on April 2, 1970.

The Isbell patent was held invalid in an earlier opinion of the Court of Appeals for the Eighth Circuit, *University of Illinois Foundation* v. *Winegard Co.*, 402 F. 2d 125 (1968). The opinion appears as Appendix C (A41-A48) to this petition. The decision of the District Court for the Southern District of Iowa, 271 F. Supp. 412 (1967), which was affirmed by the Eighth Circuit, appears as Appendix D (A49-A62). Certiorari was denied, 394 U. S. 917 (1969).

JURISDICTION.

The jurisdiction of this Court is invoked under 28 U. S. C. Sec. 1254(1). The federal jurisdiction of the District Court was based on 28 U. S. C. 1338.

As hereinafter appears, the Supreme Court has consistently exercised jurisdiction in cases such as this where a Court of Appeals has sustained an important and dominant patent (which in this case is controlled by the world's largest manufacturer of the patented item), following an earlier holding of invalidity of the same patent by another Court of Appeals. Supreme Court Rule 19(1)(b).

QUESTIONS PRESENTED.

I.

Is the Isbell patent, purporting to dominate the present-day home television receiving antenna field, valid, as held by the Court of Appeals for the Seventh Circuit in this cause; or is that patent invalid, as held a short time earlier by the Court of Appeals for the Eighth Circuit, following the latest pronouncements of the Supreme Court?

II.

Has a patentee (University of Illinois Foundation) any standing in a court of equity where, in the words of the Court of Appeals in this cause, the patentee

> "affirmatively presents a half-truth to the patent office in order to overcome a rejection,"

knowing

> "that the whole truth would support rather than overcome the rejection;"

or does such misconduct in the Patent Office, in line with

previous pronouncements of this Supreme Court, but ignored by the Court of Appeals, bar relief of patent enforcement for unclean hands, and even constitute an anti-trust violation, when such improperly obtained patent was used vigorously by the patentee and its exclusive licensee (JFD Electronics Corporation) to restrain competition?

III.

Are the requirements upon the District Court for due process and specific findings underlying the determination of "obviousness" in patent causes, as laid down by the Supreme Court in *Graham* v. *Deere*, 383 U. S. 1 (1966), mandatory or just optional and ignorable, as held by the Court of Appeals in this cause, in conceding that the

> "district court did not describe the scope and content of the prior art, identify the differences between the prior art and claim . . . nor state the level of ordinary skill in the pertinent art"

—in short, made *none* of the findings required by *Graham* v. *Deere* in connection with petitioner's patent asserted against respondents in a counterclaim?

STATUTORY PROVISIONS INVOLVED.

Questions I and III both involve 35 U. S. C. 103. Question I also involves 35 U. S. C. 102(b). Question II involves 15 U. S. C. 2 and 15 U. S. C. 14.

15 U. S. C. 2:

> *Monopolizing trade a misdemeanor; penalty*
>
> Every person who shall monopolize, or attempt to monopolize, or combine or conspire with any other person or persons, to monopolize any part of the trade or commerce among the several States, or with foreign nations, shall be deemed guilty of a misdemeanor, and, on conviction thereof, shall be punished by fine

not exceeding fifty thousand dollars, or by imprisonment not exceeding one year, or by both said punishments, in the discretion of the court. July 2, 1890, c. 647, § 2, 26 Stat. 209; July 7, 1955, c. 281, 69 Stat. 282.

15 U. S. C. 14:

Sale, etc., on agreement not to use goods of competitor

It shall be unlawful for any person engaged in commerce, in the course of such commerce, to lease or make a sale or contract for sale of goods, wares, merchandise, machinery, supplies, or other commodities, whether patented or unpatented, for use, consumption, or resale within the United States or any Territory thereof or the District of Columbia or any insular possession or other place under the jurisdiction of the United States, or fix a price charged therefor, or discount from, or rebate upon, such price, on the condition, agreement, or understanding that the lessee or purchaser thereof shall not use or deal in the goods, wares, merchandise, machinery, supplies, or other commodities of a competitor or competitors of the lessor or seller, where the effect of such lease, sale, or contract for sale or such condition, agreement, or understanding may be to substantially lessen competition or tend to create a monopoly in any line of commerce. Oct. 15, 1914, c. 323, § 3, 38 Stat. 731.

35 U. S. C. 102(b):

Conditions for patentability; novelty and loss of right to patent

A person shall be entitled to a patent unless—

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States, or

35 U. S. C. 103:

Conditions for patentability; non-obvious subject matter

A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made. July 19, 1952, c. 950, § 1, 66 Stat. 798.

Supreme Court Rule 19(1)(b):

"CONSIDERATIONS GOVERNING REVIEW ON CERTIORARI

"1. . . . The following, while neither controlling nor fully measuring the court's discretion, indicate the character of reasons which will be considered"

* * * * *

"(b) Where a court of appeals has rendered a decision in conflict with the decision of another court of appeals on the same matter; . . ."

STATEMENT OF THE CASE.

Introduction.

The University of Illinois Foundation brought suit for infringement of two of its patents in the home television receiving antenna field (3,210,767, issued October 5, 1965, in the name of D. E. Isbell; and Re. 25,740, reissued March 9, 1965, in the name of P. E. Mayes et al.) against a Chicago customer of a small New Jersey electronics firm, Blonder-Tongue Laboratories, Inc., which had just entered the antenna business. Blonder-Tongue voluntarily subjected itself to the jurisdiction of the Court to defend its customer, and counterclaimed against the University of Illinois Foundation and its exclusive licensee of these patents, JFD Electronics Corporation. In the counterclaim, Blonder-Tongue Laboratories asserted the invalidity and

non-infringement of the Isbell and Mayes et al. patents and complained of unfair competition, antitrust violation and infringement of its own patent by JFD Electronics Corporation and the University of Illinois Foundation.

The petitioner was forced to defend against the Isbell and Mayes et al. patents, through no fault of its own, without the benefit of a single witness of its own on these issues, and in a trial that was earmarked by various deprivals of due process by the District Court.

The District Court found both the Isbell and Mayes et al. patents valid and infringed and dismissed all of petitioner's counterclaims.

On appeal, the Court of Appeals for the Seventh Circuit reversed with regard to the validity of the Mayes et al. patent; reversed by holding that the University of Illinois Foundation had indeed presented half-truths to the Patent Office; sustained the finding of validity of the Isbell patent; and sustained also the dismissal of petitioner's counterclaims.

Question I.

In this case, in sustaining the Isbell patent, which purports to be the dominant patent in the home television receiving antenna field today, the Court of Appeals for the Seventh Circuit frankly states that it has made its decision in direct conflict with the earlier decision of the Court of Appeals for the Eighth Circuit (*Winegard, supra*), finding the Isbell patent invalid.

The main issue of disagreement between the two Courts of Appeals in applying the same prior art to this patent rests on the issue of the standard for "obviousness" of invention, reiterated by this Supreme Court recently in *Graham* v. *John Deere Co., supra.*

When it is reflected that petitioner was only able to pro-

duce documentary material from the *Winegard* suit in opposition to the University of Illinois Foundation's main patent case—as a result of being forced to trial after repeated postponements and at a time just after Christmas when it could not reassemble any of its witnesses—it will be observed that the Court of Appeals for the Seventh Circuit has reached what it calls a "different result" from that reached by the Court of Appeals for the Eighth Circuit, on the *same* prior art evidence. However, this "different result", a finding of non-obviousness, was reached despite the denial of petitioners right to testimony regarding the scope and content of the prior art, the differences between the prior art and the claims at issue, and the level of ordinary skill in the art.

Petitioner also asserts invalidity of the Isbell patent on the ground that the claimed subject matter was disclosed in a printed publication more than a year prior to the filing date of the application for patent, 35 U. S. C. 102(b). This defense was not relied on by the District Court or the Court of Appeals in the *Winegard* case.

On all previous occasions known to petitioner's counsel, where different Courts of Appeals have entered contradictory decisions in connection with the same patent, and particularly where the bulk of the life of the patent is yet to run (the Isbell patent has at least 12 more years before expiration), this Court has exercised its jurisdiction to resolve the conflict.[1]

See, for example, *Sanitary Refrigerator Co.* v. *Winters*, 280 U. S. 30, 35, 36; *Electric Cable Joint Co.* v. *Brooklyn Edison Co.*, 292 U. S. 69, 70; *Sola Electric Co.* v. *Jefferson Electric Co.*, 317 U. S. 173, 174-175; and *Universal Oil Products Co.* v. *Globe Oil & Refining Co.*, 322 U. S. 471, 473.

1. Supreme Court Rule 19, 1.(b) *supra*.

Suits charging infringement of this same patent have been brought by the University of Illinois Foundation against several other defendants, highlighting the importance of resolving this conflict promptly.[2]

Question II.

The University of Illinois Foundation simultaneously prosecuted the patent applications for the Isbell patent and the Mayes et al. patent here in suit. In fact, Mayes was in the same university laboratory as Isbell, and the same attorneys handled the prosecution of the two patent applications.

The patent examiner had rejected the Mayes et al. application as not constituting invention over the earlier antenna of Isbell, described in a printed publication.

In order to overcome this rejection, the attorneys prepared, and Mayes executed, an affidavit under Rule 131 of the Patent Office,[3] swearing that Mayes et al. had made the invention before the publication of this article describing the Isbell antenna.

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2. Suits have been filed against the Finney Company, Gavin Instruments, Inc., Jerrold Electronics Corporation, and Electronic Distributors, Inc. The suits have been stricken from the calendar or dismissed without prejudice, subject to further action of the parties on final disposition of the present suit.

3. "*Rule 131. Affidavit of prior invention to overcome cited patent or publication.* (a) When any claim of an application is rejected on reference to a domestic patent which substantially shows or describes but does not claim the rejected invention, or on reference to a foreign patent or to a printed publication, and the applicant shall make oath to facts showing a completion of the invention in this country before the filing date of the application on which the domestic patent issued, or before the date of the foreign patent, or before the date of the printed publication, then the patent or publication cited shall not bar the grant of a patent to the applicant, *unless the date of such* patent or *printed publication be more than one year prior to the date on which the application was filed in this country.*" (Emphasis added.)

While the District Court refused to find anything wrong in this prosecution, the Court of Appeals for the Seventh Circuit, in view of the deliberate misrepresentation before the Patent Office, was forced to overrule the District Court in this particular.

> "Neither Mayes nor counsel pointed out the fact, *known to Mayes,* that the Isbell article, with very slight revision, had first been published . . . more than one year prior to the filing date", (emphasis added)

and thus that this earlier publication could *not* be sworn back of under Rule 131.

The Court of Appeals characterized this as a case where

> "an applicant affirmatively presents a half-truth to the patent office in order to overcome a rejection when he must know that the whole truth would support rather than overcome the rejection."

From this, the Court of Appeals clearly stated the law that

> "The applicant's knowledge of a fact as to which he knows the patent office is ignorant or mistaken and which would be material under the theory he knows the patent office is applying would impose an obligation of candor."

The Court of Appeals went further and stated that, with regard to the prior publication suppressed by Mayes et al. in this affidavit,

> "It is clear that the publication date . . . would, on the theory followed by the examiner, have prevented issuance of the patent."

Not only did Mayes et al. and his counsel suppress that earlier publication, but they also suppressed still another earlier publication of which they had knowledge, which also would have supported the examiner's rejection. In the words of the Court of Appeals

"Presumably the same would be true of the publication of Quarterly Report No. 2, May 5, 1959".

Though finding this misconduct before the Patent Office, the Court of Appeals, for some reason that it failed even to mention, ignored the clear requirements of this Supreme Court that patentees who have misrepresented will not be entitled to enforcement. (See, for example, *Hazel-Atlas Glass Company* v. *Hartford-Empire Co.*, 322 U. S. 238, 246-7 (1944); and *Precision Instrument Manufacturing Co.* v. *Automotive Maintenance Machinery Co.*, 324 U. S. 805, 818, 819 (1945).)

The *Hartford-Empire* case, moreover, makes plain that equitable principles require denial of relief where the Patent Office has been subjected not to "fraud", which the Court of Appeals said it was "reluctant" to find, but for "deception" (page 246), which the Court of Appeals *did* find was practiced.

Since both the Isbell and Mayes et al. patent applications were prosecuted together, and both inventions were involved in this affidavit before the Patent Office, which the Court of Appeals found "affirmatively presents a half-truth", the Court of Appeals should have denied any relief to the plaintiff for unclean hands under established equitable doctrines and the clear mandate of the Supreme Court.

More than this, since these patents, promptly upon their issuance, were then used in tremendous advertising campaigns, App. 833, 834, and in threats and coercion by the exclusive licensee, JFD Electronics Corporation, the matter of antitrust violation appears an inescapable legal conclusion, *Walker Process Equipment, Inc.* v. *Food Machinery & Chemical Corporation*, 382 U. S. 172 (1965).

Petitioner was forced to trial for which it was completely prepared before Christmas, but for which it could not

reassemble its witnesses right after Christmas, including its patent expert as described above and, in connection with the unfair competition and antitrust counterclaims, its customer and other witnesses who also were away in the post-Christmas and New Year period.

As if this were not enough, during pendency of this suit JFD Electronics Corporation hired away from petitioner the co-inventor of petitioner's patent in suit, who had made all the tests of the Blonder-Tongue and JFD antennas and who, now in the enemy camp, was not available to present the proofs. This followed what the District Court conceded was the hiring away by JFD Electronics Corporation of the very man in charge of petitioner's antenna program, who was at the time of leaving charged with locating evidence concerning the unfair competition and antitrust aspects of this litigation, and all of whose records mysteriously disappeared the day he left. App. 510-512, 668, 689.

It is also desired to invite attention to the fact that the District Court found JFD Electronics Corporation did use the University of Illinois Foundation patents here involved to persuade customers to buy unpatented items; but the Court found this to be a normal business practice, even in light of all the above circumstances. App. 836.

Question III.

The Court of Appeals for the Seventh Circuit conceded that, in treating the counterclaim patent of petitioner,

> "the district court did not describe the scope and content of the prior art, identify the differences between the prior art and claim . . . nor state the level of ordinary skill in the pertinent art".

This, indeed, is precisely what the Supreme Court has recently held in *Graham* v. *John Deere Co., supra,* must

be found by the trial court in order to apply the standard of "obviousness" under Section 103 of the patent statute.

The Court of Appeals went on to treat this, however, as merely a discretionary requirement and not an absolute one and sustained the District Court on its finding of "obviousness" without making a single one of these determinations itself and in complete contravention of the express instructions from the Supreme Court.

REASONS FOR GRANTING THE WRIT.

The conflict between the Court of Appeals for the Seventh Circuit and the Court of Appeals for the Eighth Circuit regarding the validity of the Isbell patent, makes the patent valid in one part of the United States and not in another, and leaves the matter in doubt in other jurisdictions. The Isbell patent purports to be the dominant home television receiving antenna patent, and has many years to run, if valid. Suits are pending against several other manufacturers.

The *Electric Cable, Sola, Sanitary Refrigerator* and *Universal Oil Co.* cases, *supra,* demonstrate that this Court has constantly held it essential to grant certiorari in circumstances such as this; in the words of the *Universal Oil Co.* case, page 473

> "to resolve the conflict thus presented we granted certiorari . . ."

As stated by Wolfson and Kurland, "Jurisdiction of the Supreme Court of the United States", 1951, Section 354, at page 705,

> "A direct conflict of decisions between Courts of Appeals * * * as to validity * * * is a sufficient ground in itself for the granting of a petition for a writ of certiorari . . . The moving consideration for the grant-

> ing of the writ in these cases is the practical fact that a particular patent or claim thereof is valid in one circuit and invalid in another . . ."

With regard to the matter of unclean hands and anti-trust violation involved in patents procured by deception on the Patent Office, it is believed imperative for the Supreme Court to protect the Patent Office and the public from such practices.

Equally important is the failure of the Court of Appeals for the Seventh Circuit to follow the mandate in this regard of the Supreme Court in cases like *Precision Instrument Co.* and *Hartford-Empire, supra;* the more so when the failure to apply this law is in conflict with the way that other Circuit Courts of Appeals are now construing the law in denying enforcement of patents to patentees who do not disclose all information, in candor, to the Patent Office when they know the adverse significance that such disclosure would have. See, for example, *Beckman Instruments Inc. et al.* v. *Chemtronics, Inc., et al.*, 165 USPQ 355, 364 (CA 5, 1970); *Charles Pfizer & Co.* v. *F. T. C.*, 401 F. 2d 574, 579 (CA 6, 1968).

It is believed imperative to have all the Courts of Appeals apply the *same* doctrine laid down by the Supreme Court.

It is, of course, clear that the Supreme Court constantly takes jurisdiction to resolve conflicts in the application of law by the various Courts of Appeals.

This case presents an opportunity for the Supreme Court to make plain the *mandatory* and not *discretionary* requirements for the findings set forth in *John Deere, supra*, in connection with the determination of "obviousness" under Section 103 of the Patent Act; and at the same time to reiterate the requirements of due process for patent litigants.

While the matter of whether a particular litigant is

given a fair trial in a civil matter may not be considered in itself of sufficient import to warrant review by the Supreme Court, it is rare that a case arises in which evidence is adduced having so many aspects of public moment as the present one; and it is believed that the Supreme Court should seize this opportunity to set a new standard of business ethics which the lower courts in this instance did not seem disposed to do.

CONCLUSION.

Wherefore your petitioner prays that a Writ of Certiorari issue to the Court of Appeals for the Seventh Circuit to the end that this cause may be reviewed and determined by this Court, that the judgment of the Court of Appeals for the Seventh Circuit holding the Isbell patent valid and infringed and enforceable be reversed; and that your petitioner be granted due process in connection with its counterclaims, and such other and further relief in the premises as may be just and proper.

Respectfully submitted,

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APPENDIX A.

IN THE UNITED STATES COURT OF APPEALS
for the Seventh Circuit.

September Term, 1968 — April Session, 1969

No. 17153

UNIVERSITY OF ILLINOIS FOUNDATION,
Plaintiff and Counter Defendant-Appellee,

v.

BLONDER-TONGUE LABORATORIES, INC.,
Defendant and Counter Claimant-Appellant,

v.

JFD ELECTRONICS CORPORATION,
Counterclaim-Defendant-Appellee.

Appeal from the United States District Court for the Northern District of Illinois, Eastern Division.

February 13, 1970

Before CASTLE, *Chief Judge,* DUFFY, *Senior Circuit Judge,* and FAIRCHILD, *Circuit Judge.*

FAIRCHILD, *Circuit Judge.*

The University of Illinois Foundation brought action against Blonder-Tongue Laboratories, Inc. for infringement of two patents in the field of radio and television

antennas. Blonder-Tongue asserted invalidity of the two patents. JFD Electronics Corporation, licensed under the patents, was made a party, and Blonder-Tongue counterclaimed against JFD (principally) and the Foundation, for unfair competition, violation of antitrust laws, and infringement of a Blonder-Tongue patent.

The district court decided the Foundation's patents were valid and infringed, dismissed the unfair competition and antitrust charges, and found claim 5 of the Blonder-Tongue patent obvious and invalid. Blonder-Tongue has appealed.

Blonder-Tongue argues here, in addition to the merits issues presented to the district court, that it was not given a fair trial.

1. *Alleged deprivation of a fair trial.*

In October, 1967, after a number of postponements for the convenience of one or the other of the parties or the court, trial was set for December 18. Blonder-Tongue asserts that it was ready for trial on that day. The court, however, was unable to reach the matter and held it on call until December 20, then until December 26, then until the 27th, and then until the 28th. Trial began December 28 and lasted to January 16.

During the delay, Blonder-Tongue moved for postponement until at least February 13, showing that Mr. Blonder, its principal officer, and Professor Chu, its expert, could have appeared at a trial beginning December 18, but had conflicting and compelling other commitments in late December and January.[1]

The court denied the motions. The trial scheduled for December 18, but actually begun December 28, lasted more

1. Although reference is made to being deprived of "intended customer and other witnesses" there is no real explanation why these could not have been produced at the trial in January as well as in December.

than two weeks. Mr. Blonder did testify. Professor Chu (who had gone to Taiwan in late December) did not, but counsel has not shown the substance of testimony expected from him and not otherwise available. We find no abuse of discretion in proceeding with the trial.

2. *The patents involved.*

The Foundation is assignee of a patent, No. 3,210,767, issued October 5, 1965 to D. E. Isbell on an application filed May 3, 1960: Frequency Independent Unidirectional Antennas. This patent is reproduced in University of Illinois Foundation v. Winegard Company (S. D. Iowa, 1967), 271 F. Supp. 412, 420-424.

The Foundation is also assignee of a patent, No. Re 25,740, issued March 9, 1965 to P. E. Mayes, et al.: Log Periodic Backward Wave Antenna Array. This patent is a reissue of No. 3,108,280, applied for September 30, 1960.

Blonder-Tongue is assignee of a patent, No. 3,259,904, issued July 5, 1966 to I. P. Blonder et al. on an application filed November 21, 1963: Antenna Having Combined Support and Lead-In.

3. *Alleged Invalidity of Isbell on account of anticipation by publication.*

Isbell was associated with the Antenna Laboratory of the University of Illinois in performance of an Air Force contract. Reports were prepared and distributed from time to time pursuant to the contract. Quarterly Engineering Report No. 2 contained a description of Isbell's investigation of a type of log-periodic antenna, and it is conceded that if this report was published more than one year before May 3, 1960, the patent was invalid under 35 U. S. C. § 102(b). The printer delivered copies of the report to the

office of Miss Johnson, technical editor of the Electrical Engineering Research Laboratory, April 30, 1959. Copies were mailed out of Miss Johnson's office, pursuant to the Air Force contract, to persons on the distribution list May 5.

Blonder-Tongue contends that this report was accessible to the public on and after April 30, 1959 and therefore a printed publication more than one year before May 3, 1960.

It appears that the Engineering Research Laboratory had a "library" or reading room near Miss Johnson's office. It was unattended, and she had the keys to the cabinets in which materials were kept. It is unlikely that a copy of the report in question reached the "library" before May 3. Miss Johnson testified that a report would normally not be processed and made available as a library copy for a week or two after delivery by the printer.

The testimony as to public availability of copies on hand in her office before mail distribution was equivocal. Miss Johnson testified that if counsel had come to her office on April 30 and requested a copy of the report, he would "very likely" have been given one. She believed the copies were "available as a library reference" on the date received in her office.

Miss Johnson's immediate superior testified, however, that it was the policy to distribute quarterly reports to the list supplied by the Air Force before making them available to others.

The finding that the circumstances of the possession of the reports from April 30 to May 5 did not represent publication is not clearly erroneous.

4. *Alleged Obviousness of Isbell.*

We are met at the outset with the fact that the district court for the southern district of Iowa has decided that *Isbell* is invalid for obviousness.[2] That decision was affirmed by the eighth circuit[3] (although one of the district court's findings was deemed erroneous) and certiorari has been denied.[4] It would seem sound judicial policy that the adjudication of that issue against the Foundation in one action where it was a party would provide a defense in any other action by the Foundation for infringement of the same patent.[5]

That, however, is not the law in this field. "While the earlier decision may by comity be given great weight in a later litigation and thus persuade the court to render a like decree, it is not res adjudicata and may not be pleaded as a defense."[6]

We approach the carefully stated decisions of the district court and court of appeals in the *Winegard* action with great respect, but our own analysis, on the basis of the record and the findings of fact made by the district court in this action, and after considering the legal conclusions of the district court, leads us to a different result.

We quote here from the opinion of the district court in this action his description of the problem dealt with and the Isbell solution:

"The plaintiff's patents in suit relate to antennas having

2. University of Illinois Foundation v. Winegard Company (1967), 271 F. Supp. 412.

3. (1968), 402 F. 2d 125.

4. (1969), 394 U. S. 917, 89 S. Ct. 1191, 22 L. Ed. 2d 452.

5. See Bernhard v. Bank of America Nat. Trust & Sav. Ass'n. (1942), 19 Cal. 2d 807, 122 P. 2d 892, 894-895.

6. Triplett v. Lowell (1936), 297 U. S. 638, 642, 56 S. Ct. 645, 647, 80 L. Ed. 949, 952.

unidirectional radiation patterns essentially independent of frequency over a wide band of frequencies. The antennas covered by the patents are equally suitable for both the reception and the transmission of radiated electromagnetic energy (which includes radio and television frequency signals), but our primary concern is with their use for television reception. The characteristics desired in an antenna used for the reception of television signals are a function of the nature of frequency transmission. Although the frequency of a transmitted wave remains essentially constant as the wave moves through space, the strength of the signal decreases with increasing distance. An antenna is used to isolate the desired signal from interfering signals which exist at the point of reception and to make this signal available to the television receiver, via a transmission line, in as large a magnitude as possible.

The characteristics of an antenna which measure its performance are its gain, its bandwidth, its directivity, and its impedance. 'Gain' is the measure of its ability to increase the strength of an incoming signal relative to a fixed standard; high gain is a desired characteristic. 'Bandwidth' is its capacity to receive, without adjustment, signals of different frequencies with essentially constant gain. An antenna whose reception is essentially independent of frequency over a wide band of frequencies is known as a 'wide-band' or 'frequency independent' antenna. 'Directivity' is an antenna's ability to receive signals from one desired direction as compared to all other directions. Television antennas are preferably unidirectional in order to eliminate interference with the desired signal and the 'ghost' images such interference produces. 'Impedance' is a measure of an antenna's ability to transfer energy to the transmission line. An antenna's impedance should match as closely as possible the impedance of the transmission line to prevent the for-

mation of 'ghosts.' In the design of antennas, one desired characteristic is often obtained at the expense of another. The antenna designer's goal, of course, is to achieve the best possible balance of the several different characteristics.

The simplest antenna which has been put to practical use for television reception is the dipole antenna, which consists of a pair of linear components extending from each side of a transmission line fed in the center at the inner ends of the linear components. Shortly after 1954, the log-periodic principle of antenna design was developed. The structures designed in accordance with this principle have cyclic performance characteristics which repeat periodically as frequency is increased. Although some log-periodic structures have broadband characteristics, most do not. While a log-periodic structure can readily be designed by one using the log-periodic design principle, it cannot be predicted whether such a structure will have broadband characteristics and thus operate successfully as a log-periodic antenna.

The invention covered by the Isbell patent was made by Dwight E. Isbell during the course of his work at the University of Illinois Antenna Laboratory under an Air Force contract. Isbell's invention is a log-periodic antenna which contains a number of dipole elements arranged in a substantially planar, parallel arrangement to form an antenna array. The length of the dipoles vary from one end of the antenna to the other in accordance with a scale factor, a constant less than one, which is used to establish the length of adjacent elements. The spacing between adjacent elements also varies, preferably in the same manner. The dipoles are fed from the end of the antenna having the shortest dipoles by a twin-line feeder which provides a phase reversal of 180 degrees between adjacent dipoles by alternately connecting successive di-

pole halves. The Isbell antenna provides unidirectional radiation patterns of essentially constant beam width and input impedance for any desired band width.'"[7]

The prior art (some of which was not cited by the patent office) is described in *Winegard*, 271 F. Supp. 412, 416-418, and illustrations of portions of the prior art are appendices to that opinion, pp. 425-429.

It is true that the array described by *Isbell* appears similar in several respects to arrays known in the prior art: (1) Each dipole consists of two equal rods substantially in line with each other and with a slight separation between their ends at the center of the dipole; (2) the dipoles are parallel to each other and arrayed along an axis through their centers; (3) the length of the dipoles and the spacing between them varies; (4) two transmission lines run along the axis; (5) in any dipole, one of the rods is connected with one transmission line, and the other rod with the other line; (6) in any dipole each rod is connected with the transmission line to which the corresponding rod in each adjacent dipole is not connected.

The significant difference between the *Isbell* array and every array in the prior art which is similar in any of the respects above stated is that in *Isbell*, the lengths of successive dipoles and the spaces between the dipoles are in geometric progression, the ratio in each progression being the same, having a value less than 1, usually between 0.8 and 0.95. The *Isbell* array is logarithmically periodic. "The geometry of log-periodic antenna structures is chosen so that the electrical properties must repeat periodically with the logarithm of the frequency."[8] Dr. Du Hamel testified that the log-periodic concept is one "whereby you design the antenna and all the dimensions so that the elec-

7. An informative description also appears in the district court opinion in *Winegard*, 271 F. Supp. at 414-415.

8. Jasik, Antenna Engineering Handbook, first ed., 1961, 18-10.

trical performance must repeat periodically with the logarithm of frequency. This implies that the antenna is made of cells which are similar but are not of the same size and that adjacent cells are represented by some * * * constant factor, Tau."

The concept of log-periodic antennas was known in the prior art. The crucial question is whether it would have been obvious to a person having ordinary skill in the art and desiring to produce a frequency independent broadband antenna to construct an array of the familiar dipoles along transmission lines with such relationship between the dimensions of succesive dispoles as to produce a logarithmically periodic structure.

It is clear, from the record, that not every logarithmically periodic antenna has the desired frequency independent, broadband characteristics. It is also clear that there is no set of principles by which to predict the presence or absence of such characteristics in such structures.

"There is an infinite variety of log-periodic structures."[9]

* * * * *

"It should be pointed out that many types of log-periodic structures are not broad-band because of either extreme variation over a period of severe end effect which destroys the periodicity of the electrical characteristics. Only the successful structures are described herein. Unfortunately, it is not possible to determine a priori the frequency-independent type of log-periodic antennas.

"Since log-periodic antennas are too complex to analyze by present-day theoretical methods, they must be investigated by logical experimental methods. However, their repetitive nature greatly simplifies the initial experimental investigation because the characteristics need only be measured over one or two periods

9. Jasik, op. cit. 18-11.

of frequency. The operation over other periods may be readily predicted. Although a large amount of experimental data has been obtained, much remains to be done."[10]

The exposition of the theory of logarithmically periodic antennas principally relied on by Blonder-Tongue is an article, published in March, 1958, by Drs. Du Hamel and Ore.[11] Although the article asserts the general principle that "the geometry of logarithmically periodic antenna structures is defined so that the pattern and impedance repeat periodically with the logarithm of the frequency", the structures described as successful are markedly different in type and configuration from the array of simple dipoles along transmission lines.

Jasik, writing in 1961, says of the Isbell work, after describing more complex structures "A recent and rather simple type of log-periodic antenna is illustrated in Fig. 18-11. It consists of an array of dipoles with lengths and spacings arranged in a log-periodic manner. The dipoles are excited by a uniform two-wire line with the line transposed between adjacent dipoles."[12] He does go on to say: "It may be noticed that this antenna may be derived from that of Fig. 18-9 [two-winged "Trapezoidal Tooth Log Periodic Structure"] by letting the tooth width and the angle [beta] approach zero and then folding the two half structures about the horizontal axis so that the angle [psi] approaches zero." The observation appears correct but we deem it a hind-sight analysis, and not an indication that it would have been obvious to modify previously known figures in the manner indicated and thus produce the Isbell array.

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10. Ibid, 18-13.

11. R. H. Du Hamel and F. R. Ore, Logarithmically Periodic Antenna Designs, 1958, I. R. E. National Convention Record, 139.

12. Op. cit. p. 18-13.

As noted by the district court, Drs. Du Hamel and Ore filed a patent application March 14, 1958[13] describing structures of types which seem significantly different from a dipole array.

Dr. Du Hamel testified that he did not design an antenna using the Isbell configuration "because the design principles which we were working on did not make this an obvious result." He explained that along with the log-periodic configuration concept, and the included angular concept, design had been influenced by another concept, of a self complementary structure, one which meets the test that an identical structure would result from replacing the solid with air and the air with solid. "The complementary condition proved to not be a necessary condition in our later work, but we were still led by this to some extent in designing the log-periodic antennas that we did design."

When Dr. Du Hamel learned that the Isbell antenna worked "I was quite surprised at the simplicity of the structure, and my pride was a little bit hurt in that I had not thought of it, too, or first. * * * At first I was somewhat surprised that they worked but after thinking more about it and thinking back, then I was not surprised. At first I was surprised that it did work."

From the record before us, we do not view the situation as one where it was obvious to antenna designers that a simple dipole and the segment of line between it and the next dipole in an array would describe a cell fitting the concept of logarithmically periodic antennas, nor that some arrangement of simple dipoles in geometric progression would be a frequency independent broadband antenna, making it simply a matter of logical experimentation to find one.

13. Granted as No. 3,079,602, Feb. 26, 1963: Logarithmically Periodic Rod Antenna.

With all respect to our brethren of the eighth circuit, who saw the problem at the time of Isbell's work as "one of trial and error with a combination of commonly used elements operating within known principles of electronics and mechanics to achieve a desired result",[14] we conclude, with the district judge here, that the Isbell patent was not invalid for obviousness.

5. *Validity of Mayes patent.*

In the district court, Blonder-Tongue challenged the validity of *Mays* on the grounds of obviousness; that the patentees, Mayes and Carrel, were not the inventors; and that the patent was obtained by fraud on the patent office. Blonder-Tongue has stressed the last two on appeal.

Obviousness.

The district court found that *Mayes* "incorporates the structural characteristics of the Isbell antenna, with one modification: the dipoles in the array are inclined or V'd * * * While the Isbell antenna's dipoles provide a broad-band unidirectional antenna with an upper frequency limit established by the length of the shortest dipole in the antenna, the Mayes et al. V shaped elements permit the antenna to be operated over much higher bands of frequency and with increased directivity thus increasing the effective frequency range of the antenna and constituting an improvement over the Isbell invention."

Mayes and Isbell both worked at the Antenna Laboratory. As already seen, the Isbell structure was decribed in Quarterly Report No. 2, published May 5, 1959. The idea of V'ing the Isbell dipoles was conceived in June 1959. Thus the Isbell disclosure was prior art with respect to

14. 402 F. 2d 128.

Mayes, and the difference between subject matter of *Mayes* and prior art is the V shape of the dipoles.

Although we have concluded that it would not have been obvious at the time of the Isbell invention to experiment with arrays of simple dipoles in an effort to find a frequency independent broadband log periodic antenna, we do conclude that, given the Isbell structure, it would have been obvious to experiment with simple modifications of it, such as the V'ing disclosed in *Mayes*.

Although we prefer to rest our decision that *Mayes* is invalid upon the ground of obviousness, the facts which render the other two grounds at least plausible lend support to the conclusion of obviousness.

Invention by another.

On October 6, 1959, Dr. Mayes filled out a form reporting the invention to the Office of Naval Research. One space was designated: "Earliest date and place invention was conceived (*Brief outline of circumstances*)." He inserted the following: "On June 11, 1959, Mr. E. M. Turner of Wright Air Development Center asked if the angles of dipoles on a log period dipole array had been used as a design parameter. This was tried with no significant change in performance. The idea of operating at higher frequencies so that a change would be obtained then lead to the present invention."

The same report indicates that the first operating model was completed June 23 and the first test, with results sufficiently good to call for further testing, was made the same day.

The district court classified the thought behind Turner's question as mere surmise or theory[15] rather than the type

15. 1 Deller, Walker on Patents, 2nd ed. § 68.

of suggestion held to be really the invention in Atlantic Works v. Brady (1883), 107 U. S. 192, 2 S.Ct. 225, 27 L.Ed. 438.

Although Turner's question suggested only one simple change, such change is the whole difference between *Mayes* and *Isbell*. Whether the district court erred on the point or not, the episode is persuasive toward a conclusion of obviousness.

Alleged fraud on the patent office.

On November 6, 1962, during the prosecution of the original Mayes application, the examiner rejected certain claims. He referred to an article by Isbell in I.R.E. Transactions on Antennas and Propagation, published in May, 1960 and stated, in part, "No invention would be involved in merely arranging the Isbell dipoles in some sort of V-shape as taught by Rowland." Although a footnote to the title disclosed that the article was a revised manuscript the original of which had been previously published June 10, 1959, the examiner did not refer to the 1959 publication date, and perhaps overlooked it.

On January 10, 1963, Mayes responded to the action of November 6 by filing an affidavit under Rule 131 of the patent office, asserting that Mayes and his co-applicant, Carrel, completed their invention before May, 1960, the purpose, as counsel wrote the patent office, being "to carry their work back of the date of the publication in the IRE and back of the Isbell application filing date of May 3, 1960." Neither Mayes nor counsel pointed out the fact, known to Mayes, that the Isbell article, with very slight revision, had first been published on June 10, 1959 at about the time of the invention and more than one year prior to the filing date.

Blonder-Tongue argues that a fraud was thus practiced.

The district court rejected the allegation of fraud on the principle that an applicant is under no obligation to disclose his knowledge of references, other than those which disclose the same invention, citing Wen Products, Inc. v. Portable Electric Tools, Inc. (7th Cir., 1966), 367 F. 2d 764, 767.

We do not think the *Wen* principle would control a situation where an applicant affirmatively presents a half-truth to the patent office in order to overcome a rejection when he must know that the whole truth would support rather than overcome the rejection. The applicant's knowledge of a fact as to which he knows the patent office is ignorant or mistaken and which would be material under the theory he knows the patent office is applying would impose an obligation of candor.

We are reluctant, however, to find fraud in this instance because of the circumstance that the article relied on by the patent office itself disclosed the correct first publication date.

But these facts at least detract from the presumption of validity. It is clear that the publication date of June 10, 1959 would, on the theory followed by the examiner, have prevented issuance of the patent. Presumably the same would be true of the publication of Quarterly Report No. 2, May 5, 1959.

6. *Infringement.*

Apparently it is difficult or impossible to construct the Isbell antenna (or similar arrays with two transmission lines) so that all dipole elements lie exactly within one plane. The Isbell patent states that the dipoles are "substantially coplanar". The dipole elements of the accused Blonder-Tongue antennas lie in one of two planes which are about 1/18 of a wavelength apart. The district court

concluded these elements are substantially coplanar, and we agree.

This resolves the only issue argued with respect to the infringement found by the district court. If other issues become important as a result of our decision that *Mayes* is invalid, they will have to be resolved on remand.

7. *Unfair competition and antitrust claims.*

Blonder-Tongue made a series of charges of unfair competition and the like. The allegations included exaggerated claims in advertising, threatened litigation against competitors, improper news releases concerning litigation, intentional patent mismarking, fraud on the patent office, already discussed, raiding of Blonder-Tongue by JFD to recruit key personnel, and attempting to force customers to buy unpatented articles as a condition of obtaining patented ones.

Extended discussion is unnecessary. The best that can be said in any instance is that Blonder-Tongue presented evidence from which the district court might, but was not compelled to, draw inferences supporting the particular charge. Contrary inferences were equally, or more, reasonable. The findings made were not clearly erroneous, the standards applied as to fairness of trade practices were appropriate, and we agree with the conclusions reached.

8. *Obviousness of Blonder patent subject matter.*

The Blonder alleged invention was "primarily directed", according to the specifications, to improvement of mounting structures of antennas, stabilizing of outdoor performance, and providing for ready adjustability in indoor performance. *Blonder* does not teach a log-periodic arrangement. The very nature of the subject matter suggests that it was directed at the type of problems which might

be solved when addressed by persons with ordinary skill in the art.

The district court described the claim at issue as follows:

> "The antenna of Claim 5 comprises a pair of parallel conductors (twin booms) spaced apart vertically in a vertical plane. Dipole elements lying in vertically-spaced horizontal planes extend from the conductors at successive points along the length of the conductors, with dipole lengths increasing gradually from one end of the conductors to the other, the shortest dipoles at the front end of the conductors, where terminals connect a parallel wire transmission line to the antenna. Rigid insulating means, maintaining the terminals spaced apart, are connected with a strain relief or standoff for supporting the transmission line near the front end. Further rigid insulating means maintain the conductors' spacing at a region remote from the front end. The vertical distance between conductors is less than the distance between successive dipole elements and less than the wavelengths of the frequency band of the antenna's operation."

Unfortunately for our performance of the task of review, the district court did not describe the scope and content of the prior art, identify the differences between the prior art and claim 5, nor state the level of ordinary skill in the pertinent art. We would prefer that these steps be meticulously taken.[16]

The court did, however, list as prior art a publication, two types of antennas, and 6 patents, all in addition to the patents cited by the patent office. The court concluded that the differences between claim 5 and the prior art would have been obvious.

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16. See Cloud v. Standard Packaging Corporation (7th Cir., 1967), 376 F. 2d 384; Gass v. Montgomery Ward & Co. (7th Cir., 1967), 387 F. 2d 129; United States Gypsum Company v. National Gypsum Company (7th Cir., 1967), 387 F. 2d 799, 801-802, cert. den. 390 U. S. 988, 88 S. Ct. 1184, 19 L. Ed. 2d 1292.

The Blonder-Tongue briefs also fell short in setting forth the analysis which it would contend ought to have been made.

If we understand its position correctly, Blonder-Tongue places chief reliance upon the fact that while *Isbell* teaches that the two planes in which the dipole elements lie are to be close enough together that the dipoles are substantially coplanar, *Blonder* teaches that the planes may be separated by some distance, but less than the wavelength of the band. A substantial separation of these planes is clearly shown, however, in the 1961 publication cited by the court, Technical Report No. 52, of the Antenna Laboratory.

Mr. Blonder testified that all the mechanical elements in claim 5 were old. Combining them would, we think, have been obvious to a person of ordinary skill in the art.

Insofar as the judgment determined that Reissue Patent No. 25740 is valid and enforceable, enjoined infringement thereof, and provided for the determination and award of damages for such infringement, the judgment is reversed and the cause remanded for such further proceedings as may be required, consistent with this opinion. In all other respects, the judgment is affirmed. Defendant Blonder-Tongue shall recover from plaintiff Foundation one-third of its costs on appeal.

APPENDIX B.

IN THE UNITED STATES DISTRICT COURT.
* * (Caption—66-C-567) * *

MEMORANDUM OF DECISION.

Julius J. Hoffman, District Judge. The plaintiff and counterclaim defendant, The University of Illinois Foundation (hereinafter "the Foundation"), brings this suit, charging the infringement of two patents, against the defendant and counterclaimant, Blonder-Tongue Laboratories, Inc. (hereinafter "Blonder-Tongue"). The plaintiff is a not-for-profit corporation established under the laws of the State of Illinois and having its place of business in Champaign, Illinois. One of the Foundation's functions is to hold and administer patents covering inventions developed at the University of Illinois. Blonder-Tongue, a New Jersey corporation with its principal place of business in Newark, New Jersey, is engaged in the manufacture and sale of equipment, including antennas, for the distribution and reception of television signals. The plaintiff alleges that Blonder-Tongue has infringed two patents held by the plaintiff by manufacturing and selling television antennas embodying the inventions of these patents.

Blonger-Tongue has denied the validity of the patents in suit and has asserted that, even if they were valid, they have not been infringed by Blonder-Tongue. Blonder-Tongue has also denied their enforceability. In addition, Blonder-Tongue has brought a counterclaim against the Foundation and JFD Electronics Corporation (hereinafter "JFD"), a New York corporation in the business of manufacturing and selling, among other products, an-

tennas for use with home television receivers. The counterclaim charges that the Foundation and JFD have been guilty of unfair competition, antitrust violations, and infringement of one claim of a patent held by Blonder-Tongue.

This court has jurisdiction of the cause under 28 U. S. C. § 1338. Blonder-Tongue, which does not have "a regular and established place of business" in this District, was joined as a defendant with one of its Chicago distributors, Allied Radio Corporation, but waived its defense of improper venue and allowed Allied Radio Corporation to be dismissed.

Blonder-Tongue's Motion to Dismiss.

Blonder-Tongue's motion to dismiss the complaint for failure to prove a prima facie case, which this court stated during trial it would decide after the close of all the evidence, is denied.

The Foundation's Patents.

The plaintiff's patents in suit are Patent No. 3,210,767, entitled "Frequency Independent Unidirectional Antennas," which issued to the plaintiff on October 5, 1965, as the assignee of Dwight E. Isbell (hereinafter referred to as the Isbell patent), and Reissue Patent No. 25,740, entitled "Log Periodic Backward Wave Antenna Array," which issued to the plaintiff on March 9, 1965, as the assignee of Paul E. Mayes and Robert L. Carrel (hereinafter referred to as the Mayes et al. patent).

The Isbell patent has been previously litigated in the United States District Court for the Southern District of Iowa in *University of Illinois Foundation* v. *Winegard Company*, 271 F. Supp. 412 (S. D. Iowa 1967). The Isbell

patent was there held invalid solely on the issue of obviousness. This court is, of course, free to decide the case at bar on the basis of the evidence before it. *Triplett* v. *Lowell*, 297 U. S. 638, 642 (1936). Although a patent has been adjudged invalid in another patent infringement action against other defendants, patent owners cannot be deprived "of the right to show, if they can, that, as against defendants who have not previously been in court, the patent is valid and infringed." *Aghnides* v. *Holden*, 227 F. 2d 949, 951 (7th Cir. 1955). On the basis of the evidence before it, this court disagrees with the conclusion reached in the *Winegard* case and finds both the Isbell patent and the Mayes et al. patent valid and enforceable patents. It further finds that the two patents have been infringed by Blonder-Tongue.

Description of the Patents.

The plaintiff's patents in suit relate to antennas having unidirectional radiation patterns essentially independent of frequency over a wide band of frequencies. The antennas covered by the patents are equally suitable for both the reception and the transmission of radiated electromagnetic energy (which includes radio and television frequency signals), but our primary concern is with their use for television reception. The characteristics desired in an antenna used for the reception of television signals are a function of the nature of frequency transmission. Although the frequency of a transmitted wave remains essentially constant as the wave moves through space, the strength of the signal decreases with increasing distance. An antenna is used to isolate the desired signal from interfering signals which exist at the point of reception and to make this signal available to the television receiver, via a transmission line, in as large a magnitude as possible.

The characteristics of an antenna which measure its performance are its gain, its bandwidth, its directivity, and its impedance. "Gain" is the measure of its ability to increase the strength of an incoming signal relative to a fixed standard; high gain is a desired characteristic. "Bandwidth" is its capacity to receive, without adjustment, signals of different frequencies with essentially constant gain. An antenna whose reception is essentially independent of frequency over a wide band of frequencies is known as a "wide-band" or "frequency independent" antenna. "Directivity" is an antenna's ability to receive signals from one desired direction as compared to all other directions. Television antennas are preferably unidirectional in order to eliminate interference with the desired signal and the "ghost" images such interference produces. "Impedance" is a measure of an antenna's ability to transfer energy to the transmission line. An antenna's impedance should match as closely as possible the impedance of the transmission line to prevent the formation of "ghosts." In the design of antennas, one desired characteristic is often obtained at the expense of another. The antenna designer's goal, of course, is to achieve the best possible balance of the several different characteristics.

The simplest antenna which has been put to practical use for television reception is the dipole antenna, which consists of a pair of linear components extending from each side of a transmission line fed in the center at the inner ends of the linear components. Shortly after 1954, the log-periodic principle of antenna design was developed. The structures designed in accordance with this principle have cyclic performance characteristics which repeat periodically as frequency is increased. Although some log-periodic structures have broadband characteristics, most do not. While a log-periodic structure can readily be designed by one using the log-periodic design principle, it cannot be predicted

whether such a structure will have broadband characteristics and thus operate successfully as a log-periodic antenna.

The invention covered by the Isbell patent was made by Dwight E. Isbell during the course of his work at the University of Illinois Antenna Laboratory under an Air Force contract. Isbell's invention is a log-periodic antenna which contains a number of dipole elements arranged in a substantially planar, parallel arrangement to form an antenna array. The lengths of the dipoles vary from one end of the antenna to the other in accordance with a scale factor, a constant less than one, which is used to establish the length of adjacent elements. The spacing between adjacent elements also varies, preferably in the same manner. The dipoles are fed from the end of the antenna having the shortest dipoles by a twin-line feeder which provides a phase reversal of 180 degrees between adjacent dipoles by alternately connecting successive dipole halves. The Isbell antenna provides unidirectional radiation patterns of essentially constant beam width and input impedance for any desired band width.

The invention covered by the Mayes et al. patent was made by Paul E. Mayes and Robert L. Carrel during the course of their work at the University of Illinois under the same Air Force contract. Their antenna incorporates the structural characteristics of the Isbell antenna, with one modification: the dipoles in the array are inclined or V'd. The apex formed by the V's points in the same direction as the signal received by the antenna. The dipole element size increases in the same direction. While the Isbell antenna's dipoles provide a broadband unidirectional antenna with an upper frequency limit established by the length of the shortest dipole in the antenna, the Mayes et al. V-shaped elements permit the antenna to be operated over much higher bands of frequency and with increased directivity,

thus increasing the effective frequency range of the antenna and constituting an improvement over the Isbell invention.

Validity of the Patents.

Patentability is dependent upon three conditions explicitly set out in the federal statutes governing patents: novelty and utility, as defined in 35 U. S. C. § 101 and § 102, are non-obviousness, as set out in § 103. *Graham* v. *John Deere Co.*, 383 U. S. 1, 17 (1966). The defendant has charged that the Isbell patent is invalid because it is obvious, is anticipated by two earlier inventions, and was disclosed in a printed publication more than one year prior to the filing of the Isbell application. Blonder-Tongue also charges that the Mayes et al. patent is invalid because it is obvious, was not conceived by its purported inventors but by another, and was secured originally by a fraud upon the Patent Office.

A. The Isbell Patent.

The § 103 condition, non-obviousness, "lends itself to several basic factual inquiries." As the Supreme Court has stated, under § 103,

> the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background, the obviousness or nonobviousness of the subject matter is determined. Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented. As indicia of obviousness or nonobviousness, these inquiries may have relevancy.

Graham v. *John Deere Co.*, 383 U. S. 1, 17-18 (1966).

The primary inquiry, therefore, is the scope and content of the prior art, the differences between that prior art and the claims at issue, and the level of ordinary skill in the field. Blonder-Tongue asserts that Isbell's invention is obvious in view of the prior art, specifically (1) the K. O. antenna, the Channel Master antenna K. O. model 1023; (2) the Katzin patent, No. 2,192,532; and (3) an article by DuHamel and Ore, entitled "Logarithmically Periodic Antenna Designs," published on March 31, 1958. The court disagrees.

The K. O. antenna, sold commercially by Channel Master Corporation in or about 1955, was an antenna which employed folded dipoles. Such folded dipoles differ significantly from the straight or simple dipoles used by Isbell. Further, there was no pattern in the K. O. antenna's dipole spacing, which first increases, then decreases, then increases again from the back to the front of the antenna. The use of narrow band, simple dipoles in a log-periodic array to achieve a broadband effect was in no way suggested by the K. O. antenna.

The Katzin patent covers an array of dipole elements of differing size and different lengths, arranged in a side-by-side relationship in a plane, continuously tapering in length from one end of the antenna to the other, with smaller spacing between shorter elements than between longer ones. The patent does not exhibit log-periodic design and for this and other reasons does not suggest the Isbell antenna.

The DuHamel and Ore article, in its own language, "reports research on new types of broadband logarithmically periodic antenna structures." The characteristics of such structures were known in 1958 and the structures themselves are described. But the paper, by its own statement, proves that "no theory has been established which

even predicts the types of structures which will give frequency independent operation. * * * Thus, it is felt that a theoretical investigation of this class of antennas would be fruitful." It cannot be said that this article taught a method for designing log-periodic antennas which would predictably operate with frequency independence, and the Isbell patent was not obvious after its publication.

Much evidence in the record establishes that the design of successful log-periodic antennas was recognized by the art itself to be unpredictable. In brief, the design of such antennas at the time of the Isbell invention (and indeed even now) was a challenge to the inventor. Isbell's success was unpredicted and, the court finds non-obvious to other persons skilled in the art. In order to defeat a meritorious patent it is not enough "to pick out isolated features" in the prior art, "combine them in one particular way with hindsight acquired only from the patent under attack, and then say that no invention would have been involved in selecting those particular features and combining them in the particular way in which the patentee did." *Eversharp, Inc.* v. *Fisher Pen Co., Inc.*, 204 F. Supp. 649, 662-63 (N. D. Ill. 1961.)

As for the "secondary considerations" of obviousness or nonobviousness, such as "commercial success, long felt but unsolved needs, failure of others, etc." this court's conclusion is bolstered still more. Dr. DuHamel, among others, attempted to construct an antenna with the characteristics exhibited by Isbell's and failed. When apprised of it, DuHamel was surprised to learn that such a structure worked. There can scarcely be more convincing proof that Isbell's invention met a "long felt but unsolved need" in the antenna industry.

Apart from raising the question of obviousness, Blonder-Tongue challenges the validity of the Isbell patent on

other grounds. First, it claims that the invention was not novel because it was anticipated by the K. O. antenna and the DuHamel et al. patent, No. 3,079,602. For the reasons described above, in the court's discussion of the lack of obviousness, even in view of the K. O. antenna, the court concludes that Isbell's invention was similarly not anticipated by the K. O. antenna. The DuHamel et al. patent, filed March 14, 1958 and patented February 26, 1963, also does not anticipate the Isbell patent. It teaches a logarithmically periodic rod antenna, which is significantly different from a log-periodic antenna consisting of a dipole array, different enough so that DuHamel himself was astonished to learn of the success of the Isbell invention.

Blonder-Tongue also charges that the Isbell antenna was disclosed in a printed publication more than one year prior to the filing of Isbell's application. This question is the last remaining challenge to the Isbell patent. The plaintiff has conceded that the Quarterly Engineering Report No. 2, the publication at issue, "would have anticipated Isbell's invention if it had been published at a sufficiently early date," but argues that there is no competent evidence that the report was in fact published earlier than May 5, 1959. The question here is whether the invention was "described in a printed publication . . . more than one year prior to the date of the application for patent," which would negate patentability under 35 U. S. C. § 102. The application for the Isbell patent was filed on May 3, 1960. Hence it becomes crucial to know the date of "publication" of the quarterly report, which the plaintiff concedes describes the invention sufficiently to come within the meaning of the statute. The plaintiff acknowledges that the report was printed and was physically available prior to May 3, 1959, but denies that it was "published" earlier than May 5, 1959, on which date

the report was mailed to those persons on the distribution list.

The evidence which tends to support the defendant's position on the question of publication is the testimony of Miss Marjorie Johnson in the *Winegard* trial, of record in this case by stipulation. Miss Johnson, whose formal position with the University of Illinois in 1959 was Technical Editor of the Electrical Engineering Research Department, was responsible for distributing Electrical Engineering Laboratory publications, such as the quarterly reports. As part of her duties, Miss Johnson also kept copies of such publications in a "library" of sorts, where, because there were no supervisory personnel, materials were kept in locked cabinets and were generally obtained by request from a member of the publications staff having a key. Miss Johnson testified that the quarterly report involved here was in the publications office on April 30, 1959, and was therefore "available for distribution upon request on that date," although they were not actually distributed to persons on the distribution list until May 5, 1959. If Miss Johnson were truly a librarian and the document had been available in a genuine library, even a very small or a highly specialized library, this court would be compelled by the weight of authority to hold that such availability constituted "publication" within the meaning of § 102. See, e.g., *Hamilton Laboratories, Inc.* v. *Massengill*, 111 F. 2d 584 (6th Cir. 1940). However, the court finds the nature of the availability of the document in this case was not sufficiently "public" in nature to constitute the kind of publication intended by the act, at least until the report was distributed on May 5, 1959. In my view, the document had merely arrived from the printer and had come into the possession of the publications office on April 30, 1959, and although there existed the rather remote possibility that a person knowing of the report might have

asked for it and obtained a copy of it on that date, this kind of availability did not represent "publication."

B. The Mayes et al. Patent.

The defendant claims that the Mayes et al. patent is obvious in view of Isbell's prior work and the Carter patent, No. 1,974,387. The Mayes et al. patent represents an improvement over the Isbell patent in that its dipoles are inclined or V'd, permitting the antenna to be operated over much higher bands of frequency and with increased directivity, increasing the effective frequency range. The dipole elements are bent forward at an angle between 50 and 150 degrees, rather than being attached perpendicularly, as in the Isbell patent. The Carter patent teaches an antenna "comprising a pair of angularly disposed linear conductors," but it can hardly be said to teach the considerably more sophisticated Mayes et al. invention. It must be noted here, as observed heretofore with respect to the Isbell invention, that predictions in the field of electronics and particularly in the field of antenna design are undependable. There was no obvious basis for one skilled in the art to take the isolated features shown in the two earlier patents and to combine them as Mayes and Carrel did. Their invention was, the court concludes not obvious.

The two final challenges to the Mayes et al. patent are (1) that it was not conceived by Mayes and Carrel but by another, and (2) that it was secured by a fraud upon the Patent Office. The first contention is based upon Dr. Maye's "admission" on cross-examination that the V-construction which constitutes the only structural difference between his patent and the Isbell patent "was suggested to him by Mr. Turner of Wright Air Development Center." But, a mere suggestion by another is not enough to constitute anticipation sufficient to negate novelty.

"The mere mental conception of the desirability of doing something and of the means of doing it will not amount to anticipation. An invention is not anticipated by mere surmises or theories or by inferences as distinguished from disclosures." 1 Deller's *Walker on Patents* (2d ed.) § 68. Turner's suggestion in this instance was not an "invention" and did not anticipate the Mayes and Carrel invention. The second contention is, in brief, that the plaintiff's procuring of the Mayes and Carrel patent was "effected by an entirely misleading affidavit, either prepared willfully or through gross and wanton neglect, perpetrating a fraud on the Patent Office." The defendant makes the further argument that none of the conditions required by law for the granting of a reissue patent obtained in this case. The evidence supports neither of these charges. First, the evidence does not show that Mayes et al. misrepresented any fact to the Patent Office during the prosecution of the patent. Second, Mayes et al. were under no obligation to disclose their knowledge of references, other than those which disclose the identical invention. *Wen Products, Inc.* v. *Portable Electric Tools, Inc.*, 367 F. 2d 764, 767 (7th Cir. 1966).

In conclusion, the court finds both the Isbell and the Mayes et al. patents valid and enforceable patents.

Infringement of the Patents.

The log-periodic antennas sold by the defendant which are asserted to infringe the plaintiff's patents are antennas of two series. The first are in the Golden series, consisting of the Golden Dart and Golden Arrow television antennas, the former the outdoor, the latter the indoor models. These are UHF antennas, designed to receive television signals transmitted by channels 14 through 83, and are charged with infringing all of the claims of the

Isbell patent. It was stipulated by the parties that if the representative antenna, Plaintiff's Exhibit #10, was found to infringe, the other member of the series also infringed. The second series is the Color Ranger series, consisting of the Color Ranger-3, Color Ranger-5, Color Ranger-7, Color Ranger-10, and Color Ranger-15. These are VHF antennas, designed to receive signals transmitted by stations 2 through 13, and are asserted to infringe claims 1 through 5 of the Isbell patent and all of the claims of the Mayes et al. patent. The representative antenna is Plaintiff's Exhibit #35. It was stipulated by the parties that if it was found to infringe, all other members of the series also infringed.

The court finds that the Isbell patent is basic to both series of Blonder-Tongue's antennas. All of its claims are infringed by the Golden series, while claims 1 through 5 are infringed by the Color Ranger series. The Color Ranger also infringes all of the claims of the Mayes et al. patent. The court finds that the length of the dipoles and the spacings between adjacent dipoles in the accused Blonder-Tongue antennas follow the log-periodic arrangement disclosed and claimed in the patents in suit. Each of the antennas contains three or more parallel dipoles which vary progressively in length and spacing in accordance with a substantially constant scale factor. The scale factor for length is literally constant, in the Golden series, and the average variation from a constant scale factor for spacing is plus or minus 6%. In the Color Ranger series, the scale factor is literally constant for both length and spacing. The separation in the planar arrangement is one-eighteenth wavelength or less for both series. Although the broader the bandwidth desired, the closer an antenna must conform to the preferred construction of the Isbell antenna, where broadband requirements are not excessively great (and this is true for many practical applica-

tions), satisfactory operation can be obtained with an Isbell antenna whose dipole elements are not arranged in a strictly planar arrangement but are separated by a small fraction of a wavelength. The Blonder-Tongue antennas' dipole elements are separated by not more than one-eighteenth wavelength, making them substantially coplanar. In addition, each of the dipoles is connected by a two-conductor feeder, the conductors of which have the effect of alternately connecting the opposite dipole element of successive dipoles.

Blonder-Tongue's Counterclaim.

The counterclaim filed by Blonder-Tongue against the Foundation and JFD contains three counts. The first two counts charge unfair competition and violations of the antitrust laws; the third charges infringement of Blonder-Tongue's own patent, No. 3,259,904, issued July 5, 1966, to Isaac S. Blonder and Abraham Schenfeld.

Unfair Competition and Antitrust Violations.

Blonder-Tongue's first claim of unfair competition and antitrust violations by the counterclaim defendants is its charge against the advertising campaign utilized by JFD, as licensee under the Foundation's patents, to sell the antennas it produced pursuant to the licensing agreement. Blonder-Tongue describes some of the language employed in JFD advertisements as unfair, but the Court finds that it was within the range of acceptable sales efforts and was not so offensive as to be characterized as "unfair." For example, JFD's use of the phrase, "developed by the antenna research laboratories of the University of Illinois," in connection with its product does not violate this court's notions of what is fair competition in a highly competitive world. The fair import of this phrase is that the JFD an-

ennas were initially developed by persons at the Univer-ity, and the factual basis for such a statement is not dis-puted. The advertisements invariably added that the an-ennas were adapted for home television used by JFD; his statement is also correct. The advertising effort repre-ented by these statements and others like them cannot be leemed "unfair." See *Drop Dead Co., Inc.* v. *S. C. John-on & Son., Inc.*, 326 F. 2d 87, 96 (9th Cir. 1963), *cert. de-ied*, 377 U. S. 907 (1964).

Likewise, the alleged "mismarking" of antennas and ad-vertisements with representations of patent coverage for the JFD antennas which Blonder-Tongue asserts was mis-leading was not shown by the evidence to be either de-liberate or of damaging effect. Its effect, if any, was min-imal. There was no convincing evidence to support the conclusion that potential purchasers were influenced by such markings to buy or not to buy either JFD's or its competitors' antennas, or that such markings were delib-erately intended to gain an unfair advantage over JFD's competition. *S. W. Farber, Inc.* v. *Texas Instruments, Inc.*, 230 F. Supp. 883, 892 (D. Del. 1964), *aff'd*, 344 F. 2d 957 (3d Cir. 1965), *cert. denied*, 382 U. S. 843 (1965).

Nor was the use of the phrase "the patented log-periodic cellular formula" unfair. JFD maintains that it referred to the antenna itself, a log-periodic antenna using the pat-ented cellular concept. This is a reasonable construction of the phrase; the reader was not necessarily led to be-lieve that JFD had patented the whole concept of log-periodicity. The court's conclusion is that JFD's advertis-ing was not improper. The defendant is entitled neither to an injunction to halt allegedly unfair advertising prac-tices nor to damages resulting from a loss of business allegedly attributable to such practices, since the evidence supports neither claim.

Blonder-Tongue further contends that the counter-claim defendants, particularly the Foundation, undertook an unfair campaign to police its patents by numerous lawsuits and threats of litigation. It is conceded by Blonder-Tongue, as it must be, that there is nothing improper in bringing lawsuits against those believed in good faith to be infringers. But Blonder-Tongue's complaint is that suits were brought "to coerce the trade into dealing with JFD exclusively," that news releases concerning this litigation were "deliberately widely circulated in the trade," and that such practices "far transcend the proper use of patents and patent litigation." A review of the evidence demonstrates clearly that such allegations are wholly without basis in fact. The patentee, in the belief that its patents were valid and infringed (as they have indeed been shown to be), had the right to protect its claims by notifying the trade of alleged infringements. Its activities here were not unreasonable. *Al-Fab Aluminum Fabricators, Inc.* v. *Wagner,* 220 F. Supp. 715 (N. D. Ill. 1963). The argument that it was improper to sue Blonder-Tongue in this District is irrelevant to the claim of unfair practices made here. Blonder-Tongue might have brought timely objection to the venue but chose not to do so, and this court has not, in any case, been shown how the choice of venue has worked to Blonder-Tongue's competitive disadvantage. Even if suit had been brought in Blonder-Tongue's home state of New Jersey, news releases describing the litigation might have been distributed anywhere, including this District. From the standpoint of competition, therefore, it is immaterial that Blonder-Tongue was sued here rather than in any other District.

The claim that the Mayes et al. patent was procured improperly from the Patent Office has been discussed *supra* as part of the court's discussion of the patent's validity. There was no evidence that its procurement constituted unfair competition, as charged by Blonder-Tongue.

Blonder-Tongue makes the further claim that JFD "raided" key personnel from Blonder-Tongue, and that this constituted an unfair competitive practice. The record shows that several persons formerly in Blonder-Tongue's employ were subsequently hired by JFD and that, after the departure of one of these, some records dealing with customers were found to be missing. If the court were free to speculate on the significance of this evidence, it might be tempted to conclude, with Blonder-Tongue, that that company had been (in popular parlance) "raided" by JFD. But more than mere speculation is required to justify such a conclusion. There must be proof, and such proof is lacking here. Those employees later hired by JFD made up a small fraction of the total number of employees who left Blonder-Tongue during the same period of time, and a number of reasons, such as dissatisfaction with Blonder-Tongue, genuinely arrived at, appear from the evidence to have been instrumental in causing the employees to change their positions. The record contains no evidence that JFD "raided" Blonder-Tongue. *Dempster Bros. Inc.* v. *Perfection Steel Body Co.*, 182 F. Supp. 307, 309 (N. D. Ohio 1959).

Blonder-Tongue has also argued that JFD attempted to force its customers to purchase its unpatented products as a "tie-in" with its patented products. Proof of such a practice would constitute, of course, an antitrust violation as well as an unfair competitive practice. *Carbice Corp. of America* v. *American Patents Development Corp.*, 283 U. S. 27 (1931). The only evidence, however, which tends to support this argument is the testimony of a JFD official who admitted that JFD salesmen would try to persuade their customers to handle not only JFD antennas but its other products as well. This is a normal business practice: all salesmen try to sell their entire line of merchandise rather than merely their most popular products. There was no

probative evidence here of any coercion or threats made to customers to force their purchase of the entire JFD line. Only proof of such a compulsory tie-in would permit the court to find either an unfair competitive practice or a violation of the antitrust laws, and such proof is absent in the record.

The court concludes that JFD was not guilty of any wrongful practices with regard to the marketing and sales of their antennas. The role of the Foundation in the activities characterized by Blonder-Tongue as unfair and in violation of the antitrust laws is, on this view of the evidence, immaterial. Whether the Foundation was a "mere licensor" or something more than that is of no importance since the accused practices are not found to be beyond the reasonable bounds of competition.

Infringement of Blonder-Tongue's Patent.

The third count of Blonder-Tongue's counterclaim charges that Claim 5 of the patent held by Blonder-Tongue, the Blonder et al. patent No. 3,259,904, has been infringed by the counterclaim defendants. The antenna of Claim 5 comprises a pair of parallel conductors (twin booms) spaced apart vertically in a verticle plane. Dipole elements lying in vertically-spaced horizontal planes extend from the conductors at successive points along the lengths of the conductors, with dipole lengths increasing gradually from one end of the conductors to the other, the shortest dipoles at the front end of the conductors, where terminals connect a parallel wire transmission line to the antenna. Rigid insulating means, maintaining the terminals spaced apart, are connected with a strain relief or standoff for supporting the transmission line near the front end. Further rigid insulating means maintain the conductors' spacing at a region remote from the front end. The vertical

distance between conductors is less than the distance between successive dipole elements and less than the wavelengths of the frequency band of the antenna's operation.

The court finds that Claim 5 of the Blonder-Tongue patent was obvious at the time it was made and is therefore invalid. The alleged improvement was taught by the following references in the prior art:

1. Technical Report No. 52, published October 1, 1961, entitled "Analysis and Design of the Log-Periodic Antenna," by Robert L. Carrel;

2. the Mayes and Heslin antennas;

3. the prior art patents cited by the Patent Examiner during prosecution of the application for the Blonder-Tongue patent and the Kane, Wickersham et al., Valach, Gross, Winegard, and Callaghan patents.

Claims for Attorneys' Fees.

The plaintiff and the counterclaim defendant have each moved for an award of attorneys' fees in their favor, based upon their claims that the counterclaim was interposed and prosecuted against them in bad faith. The Foundation's claim is based upon 35 U. S. C. § 285, which reads:

> The court in exceptional cases may award reasonable attorney fees to the prevailing party.

JFD's claim is based upon "principles of equity and good practice."

Both claims will be denied. The statutory provision, as well as equity, permits such an award only where extraordinary circumstances exist and it is clear to the court that a gross injustice will be done unless such an award is made. *Siebring* v. *Hansen,* 346 F. 2d 474 (8th Cir. 1965), *cert. denied,* 382 U. S. 943. I do not find that

Blonder-Tongue's counterclaim was so vexatious and so unjustified as to make it an "exceptional case" within the ambit to the statute or within the dictates of equity. *Hyster Co.* v. *Hunt Foods, Inc.*, 263 F. 2d 130, 134 (7th Cir. 1959). Although the court has not held that the counterclaim was legally proved in any respect, Blonder-Tongue was not clearly acting in bad faith in bringing it before this court.

This memorandum of decision will stand as the Court's findings of fact and conclusions of law within the meaning of Rule 52 of the Federal Rules of Civil Procedure.

IN THE UNITED STATES DISTRICT COURT.
* * (Caption—66-C-567) * *

JUDGMENT ORDER.

This cause having come on to be heard on plaintiff's Amended Complaint, on defendant's Amended Answer and Counterclaim, and on plaintiff's and counterclaim defendant's Reply to Amended Counterclaim and the Court having heard the testimony of the Witnesses for the respective parties in open court and having examined the depositions made of record, the exhibits received in evidence and the briefs of the respective parties, and the Court having this day filed its Memorandum of Decision which said Memorandum of Decision stands as the Court's Findings of Fact and Conclusions of Law within the meaning of Rule 52 of the Federal Rules of Civil Procedure,

It Is Hereby Ordered, Adjudged and Decreed as follows:

1. The Court has jurisdiction of the parties and of the subject matter of this action.

2. The plaintiff, University of Illinois Foundation, is the owner of United States Letters Patent No. 3,210,767,

and Reissue Patent No. 25,740, and all rights thereunder, including the rights of recovery for past infringements.

3. United States Letters Patent No. 3,210,767 and Reissue Patent No. 25,740 are valid and subsisting at law and enforceable.

4. The defendant, Blonder-Tongue Laboratories, Inc., has infringed said Patents by making or causing to be made or sold antennas covered by the Claims of said Patents.

5. Judgment on the Amended Complaint is entered for the plaintiff with prejudice.

6. The defendant is the owner of United States Letters Patent No. 3,259,904 and all rights thereunder.

7. Claim 5 of United States Letters Patent No. 3,259,-904 is invalid and void in law.

8. The plaintiff and the counterclaim defendant, JFD Electronics Corporation, did not commit acts of unfair competition or acts in violation of the antitrust laws as charged in the Counterclaim.

9. Judgment on the Counterclaim filed by the defendant is entered for the plaintiff and the counterclaim defendant with prejudice.

10. A perpetual injunction shall issue out of and under the seal of this Court directed to the defendant, Blonder-Tongue Laboratories, Inc., their respective officers, agents, servants, attorneys, employees, associates and privies and those persons in active concert and participation with them or any of them, enjoining and restricting them and each of them from directly or indirectly infringing United States Letters Patent No. 3,210,767 and Reissue Patent No. 25,740 and from offering or advertising so to do, and from aiding or abetting or in any way contributing to the infringement of any of said Claims.

11. After this decree shall have become final, the Court

shall refer the matter to a Master, to be appointed by the Court, to make and render an accounting as to the extent of the manufacture and sale of infringing antennas by the defendant, and as to the amount of damages suffered by the plaintiff by reason of the defendant's infringement of United States Letters Patent No. 3,210,767 and Reissue Patent No. 25,740; and that plaintiff recover from the defendant the amount of these damages.

12. The said defendant and its officers, directors, attorneys, servants, agents, workmen and employees are hereby directed and required to attend before such Master, from time to time as required and to produce such relevant apparatus, objects, books, documents and papers as requested and to submit to examination, oral or otherwise.

13. The plaintiff shall not recover its expenses, costs or attorneys' fees.

14. The defendant shall not recover its expenses, costs or attorneys' fees.

15. The counterclaim defendant shall not recover its expenses, costs or attorneys' fees.

Enter:

JULIUS J. HOFFMAN,
United States District Judge.

Dated: June 27, 1968.

APPENDIX C.

UNIVERSITY OF ILLINOIS FOUNDATION,
Appellant,

vs.

WINEGARD COMPANY,
Appellee.

No. 19000.

UNITED STATES COURT OF APPEALS,
Eighth Circuit.

Sept. 30, 1968.

Rehearing Denied Nov. 5, 1968.
Certiorari Denied March 24, 1969.

Before MATTHES, MEHAFFY and LAY, *Circuit Judges.*

LAY, *Circuit Judge.*

The plaintiff, the University of Illinois Foundation, appeals from a judgment below denying patent validity to its United States Letters Patent No. 3,210,767,[1] relating to a "frequency independent unidirectional antenna." The plaintiff is the owner by assignment from one Dwight E. Isbell. For facility of discussion we refer to the patent itself as the "Isbell Patent." Suit was brought against the defendant Winegard Company for alleged infringement. Trial was held before the Honorable Roy L. Stephenson,

1. Plaintiff's assignor filed his application for patent on May 3, 1960.

Chief Judge of the Southern District of Iowa. Judge Stephenson held that the subject matter of the patent did not rise to the level of patentability and dismissed plaintiff's suit. See University of Illinois Foundation v. Winegard Co., 271 F. Supp. 412 (S. D. Iowa 1967).

The Isbell Patent claims a high quality television antenna for color reception, with unidirectional performance over a wide bandwidth of frequencies. The trial court denied validity to the patent in that "it would have been obvious to one ordinarily skilled in the art and wishing to design a frequency independent unidirectional antenna to combine * * * prior art references * * *." Id. at 419.

There is no necessity to set forth the full discussion of the facts relating to the prior art. These appear in the excellent analysis made by the Chief Judge below. We have examined the record and find that all claims must be denied, lacking nonobviousness as a matter of law for essentially the same reasons set forth by the court below.

Plaintiff urges that the trial court erred in denying patent validity and calls our attention to a subsequent decision in a federal district court in Illinois which upholds the validity of the same patent against another defendant, University of Illinois Foundation v. Blonder-Tongue Laboratories, Inc., N. D. Ill., Civ. No. 66 C 567. However, as recognized by the district court in Illinois, we must determine this case on its own record.[2]

The plaintiff basically urges on appeal that the district court in the present case erred in finding that "those skilled in the art at the time of the Isbell application knew * * * the log periodic method of designing frequency independ-

2. Compare this court's holding in Imperial Stone Cutters, Inc. v. Schwartz, 370 F. 2d 425 (8 Cir. 1966), invalidating the letters patent previously upheld in 1958 by another panel of our court on a different record in Ezee Stone Cutter Mfg. Co. v. Southwest Indus. Prods., Inc., 262 F. 2d 183 (8 Cir. 1958).

ent antennas." On the face of the record we must agree that this finding is erroneous. The record discloses that the log-periodic formula[3] for antenna design was a recognized theory within the calling. This formula is discussed in the authoritative article by Drs. Hamel and Ore entitled Logarithmically Periodic Antenna Designs, published in March of 1958. However, as pointed out by plaintiff, this same article discloses:

> "Unfortunately, no theory has been established which even predicts the types of structures which will give frequency independent operation."

Jasik's Antenna Engineering Handbook, a recognized authority in the field, verifies on page 18: "* * * it is not possible to determine *a priori* the frequency independent type of log-periodic antennas." The record is clear that both plaintiff and defendant experts agreed with this fact.

Thus, we feel the evidence only discloses the adaptation by plaintiff of the log-periodic formula to obtain geometric proportional spacing across its bandwidth. It did not teach that said spacing will in itself achieve frequency independent operation. As we view the record it is the achievement of frequency independent operation through

3. As summarized by the trial court:

"Generally stated, log periodic antennas are designed according to the theory that an antenna 'design cell' having high performance characteristics for reception of a limited band or period of radio frequency signals, if altered in all dimensions by a constant scale factor will have high performance characteristics for reception of a band of signals having wavelengths which vary from the wavelengths of the first band of frequencies by the same constant scale factor. Thus, according to the theory, if an antenna design cell has certain characteristics for reception of particular frequency wavelengths, an antenna geometrically similar but reduced in all dimensions by a scale factor of .5 will have similar characteristics for reception of frequencies of wave lengths half those of the first." University of Illinois Foundation v. Winegard Co., 271 F. Supp. 412, 417 (S. D. Iowa 1967).

the use of the dipole array which is the principal claim of the Isbell Patent. Both parties' experts agree that with frequency independent operation "severe end-effects" and unstable performance is avoided. A frequency independent antenna is one in which the basic electrical characteristics remain substantially constant over a given frequency range. These characteristics generally relate to uniform gain, bandwidth, directivity and a good impedance match. Unless an antenna achieves frequency independent operation it will not offer the high quality performance over a wide band of frequencies needed for commercial operation.

However, we do not view the acknowledged fact of the unpredictability of the frequency independent operation of the Isbell Patent as requiring us to reach a result different than held below. Nor was the trial court's finding in this regard essential to its overall reasoning that the patent itself was made obvious by the prior art. The statutory standard of patentability under § 103 is not "predictability." This terminology helps to obscure the true issue of "nonobviousness." The valid test relates the subject patent to whether its development would be obvious to one skilled in the art. As stated by Mr. Justice Clark, the test of nonobviousness "is one of inquiry, not quality * * *." Graham v. John Deere Co., 383 U. S. 1, 17, 86 S. Ct. 684, 15 L. Ed. 2d 545 (1966). As we have often repeated such inquiry relates to: (1) scope and content of the prior art, (2) differences between the subject patent and the prior art, (3) the level of the skill in the art at the time involved and (4) secondary considerations relating to commercial success, long-felt need, et al. And of course, the latter factors cannot alone determine patentability. National Connector Corp. v. Malco Mfg. Co., 392 F. 2d 766 (8 Cir. 1968).

Therefore, we deem the sole legal issue in the instant case to be whether a person skilled in the calling could

improve with the skill of the calling the prior art by obvious means.

The mere fact that the "invention" was not previously known or developed is not the test. Where logical exploration within known principles of the science achieves an unpredictable result, even though a commercially desirable one, the burden of nonobviousness is not necessarily overcome. In other words, the necessity of logical experimentation does not in and of itself negate obviousness.[4] Cf. General Mills, Inc. v. Pillsbury Co., 378 F. 2d 666 (8 Cir. 1967).

As early asserted by Mr. Justice Bradley in Atlantic Works v. Brady, 107 U. S. 192, 199-200, 2 S. Ct. 225, 231, 27 L. Ed. 438 (1882):

> "The process of development in manufactures creates a constant demand for new appliances, which the skill of ordinary head-workmen and engineers is generally adequate to devise, and which, indeed, are the natural and proper outgrowth of such development. Each step forward prepares the way for the next, and each is usually taken by spontaneous trials

4. In Minnesota Mining & Mfg. Co. v. Coe, 69 App. D. C. 217, 99 F. 2d 986, 989 (1938), the court said:

> "But a showing of great industry in experimental research is not in itself sufficient to constitute invention, when the product thereof differs from those of the prior art only in degree and the result—no matter how useful it may be—is merely one step forward in a gradual process of experimentation."

In Busell Trimmer Co. v. Stevens, 137 U. S. 423, 435, 11 S. Ct. 150, 154, 34 L. Ed. 719 (1890), the United States Supreme Court said:

> "But the patent before us is no such case. The most that can be said of it is that it shows, on the part of Orcutt, great industry in acquiring a thorough knowledge of what others had done in the attempt to trim shoe soles in a rapid and improved mode, by the various devices perfected by patents for that purpose, good judgment in selecting and combining the best of them, with no little mechanical skill in their application; but it presents no discoverable trace of the exercise of original thought."

> and attempts in a hundred different places. To grant to a single party a monopoly of every slight advance made, except where the exercise of invention, somewhat above ordinary mechanical or engineering skill, is distinctly shown, is unjust in principle and injurious in its consequences."

Plaintiff urges Isbell had to overcome two serious handicaps which hid the developmental obviousness: (1) the use of linear dipoles to achieve a broad-band result, and (2) the mismatch of impedance. The simple answer to this argument is that the "problems" presented were never recognized beyond experimental correction by those skilled in the calling. Although linear dipoles may have been used with "narrow-band" antennas, such configuration had been shown to be used with antennas having broad-band characteristics. Defendant's tests demonstrated they had substantially the same characteristics (except impedance) as the "folded dipole." They had been utilized interchangeably by experimental engineers. These equivalent characteristics were known long before the Isbell Patent.

The problem of matching impedance was one of adjustment. However, matching impedance is an elementary problem to those skilled in radio electronics. Impedance is recognized as the resistance to the flow of current. It is fundamental that efficient performance of any antenna occurs only through a maximum power transfer of the transmission line to the antenna itself. This requires matching impedance as much as possible. No claim of "invention" is asserted to overcome the mismatch, only that the antenna itself was, therefore, not obvious. The ability to match impedance with the linear dipole array was not new to the development and exploration which led to the Isbell antenna. There was not involved the same deterrent as experienced in United States v. Adams, 383 U. S. 39, 86 S. Ct. 708, 15 L. Ed. 2d 572 (1966), where

chemicals were interchanged, admittedly non equivalents, to achieve the "water battery." The problem here was one of trial and error with a combination of commonly used elements operating within known principles of electronics and mechanics to achieve a desired result. Cf. Marconi Wireless Tel. Co. of America v. United States, 320 U. S. 1, 63 S. Ct. 1393, 87 L. Ed. 1731 (1942).

In Jasik's Antenna Engineering Handbook it is stated on page 1813:

> "Since log-periodic antennas are too complex to analyze by present-day theoretical methods, they must be investigated by *logical experimental methods.*[5] However their repetitive nature greatly simplifies the initial experimental investigation because the characteristics need only be measured over one or two periods of frequency." (Emphasis ours.)

Plaintiff claims that the frequency independent operation of the Isbell antenna was accomplished by "specified scaling factors to determine dipole length, design cell dimensions, and spacing between dipoles." Here again, the evidence reflects that plaintiff did nothing more than logical and mechanical experimentation within suggested principles and design from the existing art. As the trial court found, there exists a direct relationship between the length

5. Mr. Winegard of the defendant company relates the experimental engineers' approach:

> "Well, in the early days I used to calculate the resonance. There's so many factors with respect to the length of the element—if you are just concerned with one dipole, one straight dipole, it would be very easy to determine the actual length by calculation, but when you place several elements together there is always an inter-action which will affect the length, so in order to get optimum performance from an array it is necessary to tune the antenna by slightly modifying the actual length of the—I have been working with antennas so long it is like learning the English language, you don't have to look at the dictionary every time to figure out how to spell 'and.' You know what I mean?"

and cell dimension of the Isbell claims and those of the prior art found within the K. O. antenna. And plaintiff's own expert discounted the significance of the dipole spacing as a design factor.

Problems of impedance, patterns, resonance, gain, directivity and bandwidth, may all vary upon experimentation within recognized principles of elements having known interrelated electrical characteristics. And naturally, only high quality performance will be the optimum design array desirable. Such experimental combination of common elements and principles, e.g., dipole array, transposed feed, end fed and log-periodic formula, by selected spacing to obtain an improvement of both antenna design and performance, does not obviate the test of nonobviousness. If this were not true, at least in the instant case, nonobviousness would depend simply upon achieving a new result. The standard of patentability under § 103 requires more.

Judgment affirmed.

APPENDIX D.

UNIVERSITY OF ILLINOIS FOUNDATION, *Plaintiff*,

v.

WINEGARD COMPANY, *Defendant*.

Civ. No. 3-695-D.

UNITED STATES DISTRICT COURT

S. D. Iowa,

Davenport Division.

June 23, 1967.

As Amended July 18, 1967.

MEMORANDUM OPINION.

STEPHENSON, *Chief Judge*.

This action was brought by the plaintiff University of Illinois Foundation, the owner by assignment of U. S. Patent 3,210,767, issued to Dwight E. Isbell on October 5, 1965 (hereinafter referred to as the Isbell Patent and attached hereto as Appendix A), against the defendant Winegard Company wherein the plaintiff seeks a finding that said patent has been and is being infringed by the defendant. In its answer the defendant alleges, *inter alia*, invalidity of the patent on the grounds that the invention was disclosed more than one year prior to the date of the application for the patent and that, at the time made, the invention was obvious to one skilled in the art. Jurisdiction is established by virtue of 35 U. S. C. § 281 and 28 U. S. C. § 1338.

Inasmuch as the defendant alleges invalidity of the patent as a defense, the Court must determine initially whether or not the Isbell patent is valid. General Mills, Inc. v. Pillsbury Co., 378 F. 2d 666 (8th Cir., 1967); American Infra-Red Radiant Co. v. Lambert Indus., Inc., 360 F. 2d 977, 983-984 (8th Cir., 1966). Of course, a patent, from the fact of its issuance is presumed to be valid. 35 U. S. C. § 282; Radio Corporation of America v. Radio Engineering Laboratories, Inc., 293 U. S. 1, 7-8, 55 S. Ct. 928, 79 L. Ed. 163 (1934); L & A Products, Inc. v. Britt Tech. Corp., 365 F. 2d 83, 86 (8th Cir., 1966); American Infra-Red Radiant Co. v. Lambert Indus., Inc., supra, 360 F. 2d at 988-989. However, this presumption of validity is weakened when, as in this case, there are prior art references or alleged disclosures of the patent before the Court that were not considered by the patent office during the prosecution of the application for the patent. Imperial Stone Cutters, Inc. v. Schwartz, 370 F. 2d 425, 429 (8th Cir., 1966); American Infra-Red Radiant Co. v. Lambert Indus., Inc., supra, 360 F. 2d at 989; Greening Nursery Co. v. J & R Tool & Mfg. Co., 252 F. Supp. 117, 139 (S. D. Iowa, 1966), aff'd, 376 F. 2d 738 (8th Cir., 1967).

There are three separate conditions precedent to patent validity. They are: Novelty, utility, and nonobviousness. 35 U. S. C. §§ 101-103; Graham v. John Deere Co., 383 U. S. 1, 12, 86 S. Ct. 684, 15 L. Ed. 2d 545 (1966); United States v. Adams, 383 U. S. 39, 48, 86 S. Ct. 708, 15 L. Ed. 2d 572 (1966); L & A Products, Inc. v. Britt Tech. Corp., supra, 365 F. 2d at 85. In this case the defendant relies on lack of novelty (Title 35 U. S. C. Section 102) and obviousness (Section 103) as barring patentability. It is the opinion of the Court that the issue of obviousness is dispositive of this case. Therefore, that issue will be first considered.

While the ultimate question of patent validity is one of law, the determination of the question of obviousness lends itself to several basic factual inquiries. Graham v. John Deere Co., supra, 383 U. S. at 17, 86 S. Ct. 684; L & A Products, Inc. v. Britt Tech. Corp., supra, 365 F. 2d at 86. In addition to setting out the scope of the patent in suit, the scope and content of the prior art must be defined so that a determination can be made as to whether the differences between the patent in suit and the pertinent prior art would have been obvious to one ordinarily skilled in the art. If such differences as may exist would have been obvious to a person ordinarily skilled in the art, the obviousness test of 35 U. S. C. § 103 has not been met and the patent will be invalid. Graham v. John Deere Co., supra, 383 U. S. at 37, 86 S. Ct. 684, General Mills, Inc. v. Pillsbury Co., supra.

The Patent in Suit.

The Isbell Patent is entitled "Frequency Independent Unidirectional Antennas" and relates to antennas designed for the transmission and reception of electromagnetic radio frequency signals. These signals are used for the broadcasting of many types of communications including radio and television signals. The Isbell antenna consists of a plurality of elements called "dipoles"[1] which are

1. Generally, in this context, a simple straight dipole antenna element consists of two elongated metallic conductors (wires, rods or tubes) arranged approximately colinearly in such a manner that there is a small gap or terminal between their inner ends, at which point a transmission line is attached. The familiar "rabbit-ear" indoor television antenna is a simple dipole having its arms at an angle rather than in a straight line. When immersed in an electromagnetic field the dipole element will intercept electromagnetic radio waves and produce a voltage across the terminal. This voltage is carried to the receiver by means of the transmission line. The dipole antenna element, like any other electrical conductor, will intercept radio energy from the atmosphere to a limited extent, regardless of the frequency of the energy being transmitted. There

arranged in relation to each other and connected to each other in a particular manner. Generally, as stated in the patent specification, "the antennas of the invention are coplanar dipole arrays consisting of a number of dipoles arranged in side-by-side relationship in a plane, the length and the spacing between successive dipoles varying according to a definite mathematical formula, each of the dipoles being fed by a common feeder (transmission line) . . . ."[2] According to the patent specification,

> The lengths of the dipoles and the spacing between dipoles are related by a constant scale factor τ defined by the following equations:
>
> $$\tau = \frac{L_{(n+1)}}{L_n} = \frac{\Delta S_{(n+1)}}{\Delta S_n}$$
>
> where τ is a constant having a value less than 1, L_n is the length of any intermediate dipole in the array, $L_{(n+1)}$ is the length of the adjacent smaller dipole, ΔS_n is the spacing between the dipole having the length L_n and the adjacent larger dipole, and $\Delta S_{(n+1)}$ is the spacing between the dipole having the length L_n and the adjacent smaller dipole.[3]

The feeder or transmission line consists of two conductors, one of which is connected to the inner end of one-half

---

is, however, a special condition, known as "resonance", in which the dipole is strongly receptive, which occurs when the dipole is of a particular length in relationship to the wavelength of the radiated energy. This condition occurs primarily when the overall length of the dipole is one-half of the wavelength of the radio wave. Thus, it is apparent that a dipole can be "tuned" for optimum reception of a particular radiowave frequency by adjusting the overall length of the dipole. The relative ability of one antenna to produce a signal (i.e., a radio frequency voltage) at a given location distant from the transmitting station in comparison with another antenna similarly located is a measure of the antenna's "gain," a technical term used in the industry in reference to an antenna's signal-producing capabilities.

2. Isbell Patent, Col. 1, lines 14-19. See App. A.

3. Isbell Patent, Col. 1, lines 50-62. See App. A.

of each dipole, the other being connected to the inner end of the other half of the dipole, and transposed between connections of successive dipoles in such a manner that each conductor is connected alternately to the left and right halves of successive dipoles. (See Appendix A, Fig. 1.)

Antennas designed in accordance with the patent specifications are claimed to have unidirectional radiation patterns and high quality performance which are, over a wide band of frequencies, essentially independent of the frequency of the electromagnetic radio waves being transmitted or received. An antenna with such characteristics is, of course, desirable when the reception of many different frequencies is required as one such antenna may be used in place of many antennas which are each capable of receiving a limited number of frequencies. Since VHF television signals are broadcast over a range of frequencies of 54 megacycles/second to 216 megacycles/second,[4] an antenna capable of receiving high quality signals with uniform performance characteristics in that range of frequencies would be of commercial utility. This is particularly true in respect to the reception of color television signals where the minimum standards of performance are higher than those required for satisfactory black and white television reception.

There are fifteen claims in the Isbell patent. See Appendix A. All of the claims except numbers 6, 7 and 8 are

4. Channels 2-6 broadcast over radiowave frequencies 54-88 megacycles/second, each channel being assigned a band 6 megacycles wide in which to broadcast. Thus, channel 2 broadcasts over the range 54-59 megacycles/second; channel 3, 60-65 megacycles/second; etc. Channels 7-13 broadcast over frequencies 176-216 megacycles/second, with 89-175 megacycles/second being assigned to non-television broadcasting. While some of the antennas accused of infringing are designed for the reception of VHF and UHF (470-890 megacycles/second) signals, it is only the VHF sections of these antennas that are alleged to be infringements of the Isbell patent.

claimed to be infringed by one or more of twenty-two models of defendant's antennas which are designed for the reception of television signals.[5] Specifically, all twenty-two models are alleged to be literal infringements of claim 14 and 15 and also within the inventive concept of claims 1-5 and 9-13. In addition, one of the antennas, the chromatel two models are alleged to be literal infringements of claims 1, 2, 9, 10, 11, and 12. It should be noted here that while the portions of the antennas which are charged as infringing are designed solely for the reception of VHF television signals, the Isbell antenna is not so limited. It is designed both as a receiving antenna and a transmitting antenna for use in an unlimited range of frequencies. For example, the specification indicates that the antenna has very high performance characteristics over as high a range as 1100 to 1800 mc/sec.[6]

Prior Art.

Four prior patents are cited in the patent as having been considered by the patent examiners. One of these patents, five other U. S. patents not referred to by the examiners, an article published on March 31, 1958 and three antennas in use prior to 1959 are among the references relied upon

5. The Winegard antennas that are alleged to be infringements of the Isbell patent are the models with the following numbers:

Chromaflex	B-445	R.C.A.	10-B-200
"	B-550	"	10-B-300
"	B-555	"	10-B-400
"	B-660	"	10-B-1010
"	B-770	"	10-B-1020
"	B-105	"	10-B-1030
"	B-335	"	10-B-1040
Chromatel	CT-40	"	10-B-1050
"	CT-80	"	10-B-1120
"	CT-90	"	10-B-1130
"	CT-100	"	10-B-1140

6. Isbell Patent, Col. 2, lines 47-52. See App. A.

by the defendant as revealing the prior art at the time of the invention. An examination of some of these references will be helpful in defining the state of the prior art on May 3, 1960, the date of the filing of the application for the patent.

The Katzin patent (U. S. Patent No. 2,192,532, the first page of which is attached hereto as Appendix B) cited by the patent office reveals an antenna consisting of an array of dipole elements of different lengths arranged in a side-by-side relationship in a plane. While some of the illustrated embodiments of the Katzin invention show antennas having several elements of one length arranged parallel to several elements of another length, one illustrated embodiment (Figure 3c, Appendix B) shows an array described in claim 7 of the patent as being "a plurality of aerial elements, all of differing length, continuously tapering in length from one end of said antenna to the other * * *."[7] The patent also suggests, in claim 11 thereof, that the spacing between the shorter elements may be less than that between the longer elements.[8] The teaching of the Katzin patent is that if elements, or groups of elements, of differing lengths are combined into one array, each of the elements, or groups of elements, "will respond most efficiently to its corresponding band of frequencies, so that the combination of two or more such groups * * * will give the result of a high response for a wider frequency band."[9]

One of the antennas cited as prior art by the defendant is the Channel Master "K. O." antenna model 1023, produced and marketed by the Channel Master Corporation at Ellenville, N. Y. between September 1954 and December

7. U. S. Patent No. 2,192,532, p. 2, Col. 2, lines 54-58.

8. U. S. Patent No. 2,192,532, p. 3, Col. 2, lines 5-14; See also Fig. 3d, App. B.

9. U. S. Patent No. 2,192,532, p. 2, Col. 1, lines 16-21.

1958. A schematic diagram of this antenna, Exhibit DX-G-16, is attached hereto as Appendix C. This antenna is an array of *folded* dipoles,[10] each of a different length, arranged in a coplanar side-by-side relationship decreasing in length from one end of the array to the other. The spacing between the dipole elements is irregular, the elements not being equally spaced and the spacing not varying progressively from one end of the array to the other. The feeder or transmission line running between the elements consists of two conductors, one of which is connected to one end of the folded dipole at the terminal point, the other connected to the other end of the dipole at the terminal point, and transposed between dipoles such that each conductor is alternately connected to the left and right ends of successive dipoles. Transposed feeder lines are also shown in the Koomans Patent (U. S. Patent No. 1,964,189, the first page of which is attached hereto as Appendix D) and the Winegard Patent (U. S. Patent No. 2,700,105, the first page of which is attached hereto as Appendix E), both of which are cited as prior art by the defendant. The White Patent (U. S. Patent No. 2,105,569, the first page of which is

10. Folded dipoles are simple dipoles, see n. 1, supra, which have been altered by adding another conductor in such a manner that it is approximately parallel to the simple dipole and attached to the outer ends of each half of the simple dipole. The resulting structure is an elongated loop having a terminal point midway along one of its longer sides. (See App. C) Folded dipoles have somewhat different characteristics than straight or simple dipoles, the primary differences being that folded dipoles have better performance over a greater band-width of frequencies and that folded dipoles have a greater resistance to the flow of electric current than do simple dipoles. This resistance to the flow of current is known as "impedance." In order to achieve the maximum transmission of the signal to the receiver, the impedance of the antenna, the transmission line and the receiver should be as nearly equal as possible. Television transmission line and receivers have an impedance set by FCC regulation at about 300 ohms. A simple dipole has an impedance of about 75 ohms while a folded dipole has an impedance of about 300 ohms.

attached hereto as Appendix F) also uses transposed feeder lines in conjunction with dipole elements decreasing in length from one end of the array to the other. However, the White array is "center-fed," that is, connected to the down lead transmission line which leads to the receiver, at the center of the array, rather than at the end of the array. The antennas described in the Katzin, Koomans, and Winegard patents noted above and the "K. O." antenna, as well as the Isbell antenna, are all fed at the end of the antenna having the smaller elements.

The article cited by the defendant Winegard as prior art is "Logarithmically Periodic Antenna Designs" published by R. H. DuHamel and F. R. Ore on March 31, 1958. This article explains the elements of the theory of logarithmically periodic (log periodic) antennas and the development of several such antennas. Generally stated, log periodic antennas are designed according to the theory that an antenna "design cell"[11] having high performance characteristics for reception of a limited band or period of radio frequency signals, if altered in all dimensions by a constant scale factor will have high performance characteristics for reception of a band of signals having wavelengths which vary from the wavelengths of the first band of frequencies by the same constant scale factor. Thus, according to the theory, if an antenna design cell has certain characteristics for reception of particular frequency wavelengths, an antenna geometrically similar but reduced in all dimensions by a scale factor of .5 will have similar characteristics for reception of frequencies of wavelengths half those of the first. The theory continues that if a par-

11. The term "design cell" is used herein to refer to a structural unit of an antenna which is capable of receiving and transmitting electromagnetic radio energy. A simple or folded dipole and an adjacent section of transmission line are examples of such antenna design cells. A particular antenna array may be composed of one or more similar or dissimilar design cells.

ticular design cell is reduced successively by a constant scale factor which is less than 1, and repeated periodically in one antenna "array", the array will have the characteristics of the design cell over a broader band of frequencies which is limited only by the largest and smallest of the geometrically similar design cells which are repeated in the array. Because the performance of the antennas so designed is theoretically the same over any band of frequencies for which the antenna is designed the antennas are termed Frequency Independent Antennas. The application of this theory to antenna design appears to be limited only by the conditions that the design cell used must have uniform performance over a single period and that the overall array, the periodic repetition of the cell, not cause an "end effect"[12] that would destroy the frequency independence of the array.

The formula set out by DuHamel and Ore as defining the relationship between the repeated, or periodic, design cells is: $\tau = \frac{R_{n+1}}{R_n}$, which defines a constant proportional relationship between like elements of the design. In this case the formula relates to the radii of circular structures. Of course, in the case of geometrically similar designs all dimensions of one design are proportionally equal to all dimensions of the other similar designs. That is, they must all vary proportionally. The theory of the log periodic

12. Very generally stated, "end effect" is a term used to describe a bouncing back and forth, from one end of an antenna array to the other, of any energy that is not fully transmitted or absorbed by the elements of the antenna as the energy travels initially along the antenna. This bouncing, or reflection, back and forth may cause shadows or ghosts in the reception of a television picture. Thus, in order to avoid this end effect an antenna should be designed to have sufficient elements to radiate or absorb all of the energy as it passes from one end of the antenna to the other so that there will be no such reflection of the energy back down the antenna.

antenna was adopted by Isbell in his work and the formula, $\tau=\frac{L_{(n+1)}}{L_n}=\frac{\Delta S_{(n+1)}}{\Delta S_n}$ where τ is a constant having a value of less than 1, can be seen to be a simple adaptation of the DuHamel-Ore formula[13] and its mathematical equivalent.

The Invalidity of the Patent

Keeping in mind the prior art previously discussed, it can be seen that an antenna with the general parameters of the Isbell Patent will result from a combination of the dipole array of Katzin with the transposed feeder line of the Channel Master "K. O." or the Koomans or Winegard Patents. Such an antenna would consist of a coplanar side-by-side array of straight dipole elements of differing lengths which decrease in length and spacing from one end of the array to the other (as disclosed by claims 7 and 11 of the Katzin patent), fed at the small end of the array by a two conductor transmission line that is trans-

13. While DuHamel and Ore defined circular structures by relating the radii of different parts of one cell to the radii of another, Isbell has defined linear structures by relating the lengths and spacings of one design cell to another. That these are alternative means of expressing the same mathematical relationship is evident from an examination of Figure 1 of the Isbell patent and the discussion, found in Col. 1, line 63 to Col. 2, line 2 of the patent, relative to the distance from the base line O, in Figure 1, to the dipole having the length Ln. If the distance from the base line O to dipole having the length Ln were the radius of a circle having its axis at line O and its circumference tangent to the same dipole, the distance represented by Xn ("the distance from the base line O to the dipole having the length Ln", see Col. 1, lines 71-72 of Appendix A) would be equal to Rn, where Rn is the radius of the said circle having its axis at O and its circumference tangent to the dipole of length Ln; then, it is easily seen that the formulas $\tau=\frac{Rn+1}{Rn}$ (Isbell) and $\tau=\frac{X\,(n+1)}{Xn}$ (DuHamel & Ore) are different but equal mathematical expressions of the same proportional relationship.

posed between successive elements (as disclosed by the Koomans and Winegard Patents and the Channel Master "K. O." antenna). Further, if the length and spacing of the dipole elements in such an antenna are adjusted by the log periodic theory of antenna design which dictates that the periodic or repeating cells (here a dipole element and adjoining section of transmission line) shall be geometrically similar and related to each other in size by a constant scale factor, the result is the Isbell antenna disclosure. It is thus apparent that the Isbell antenna is a combination of elements, all known in the prior art and also that these known elements were combined in the Isbell antenna in a manner dictated by a theory also known in the prior art. Therefore, the critical question is whether such a combination would have been obvious to one reasonably skilled in the art of antenna design. United States v. Adams, supra, 383 U.S. at 50-52, 86 S.Ct. 708, 15 L.Ed.2d 572; Kell-Dot Indus., Inc. v. Graves, 361 F.2d 25, 30 (8th Cir., 1966); American Infra-Red Radiant Co. v. Lambert Indus., Inc., supra, 360 F.2d at 988. Those skilled in the art at the time of the Isbell application knew (1) the log periodic method of designing frequency independent antennas, (2) that antenna arrays consisting of straight dipoles with progressively varied lengths and spacings exhibit greater broad band characteristics than those consisting of dipoles of equal length and spacing and, (3) that a dipole array type antenna having elements spaced less than ½ wavelength apart could be made unidirectional in radiation pattern by transposing the feeder line between elements and feeding the array at the end of the smallest element.

It is the opinion of the Court that it would have been obvious to one ordinarily skilled in the art and wishing to design a frequency independent unidirectional antenna to combine these three old elements, all suggested by the prior

rt references previously discussed.[14] The test of obvious-ess is the proper test to be applied in determining whether new combination of known elements is patentable. Amer-an Infra-Red Radiant Co. v. Lambert Indus., Inc., supra, 60 F.2d at 988. When one skilled in the art with the rior art references before him could have, without the xercise of inventive faculty, combined old elements known n the art to produce the plaintiff's "invention," the "in-ention" does not rise to the level of patentability not-withstanding the fact that it may be an improvement over he prior art. Kell-Dot Indus., Inc. v. Graves, supra, 361

14. It should also be noted that the File Wrapper of the Isbell atent indicates that on November 9, 1960, all original 9 claims inal claims 1-8 and another never approved) were initially re-cted by examiner G. N. Westby as being met by Katzin (Patent o. 2,192,532, App. C) in view of other patents teaching the cross-g of the feeder line and the use of straight tubular conductors. n May 10, 1961, Isbell submitted an amendment to the Patent ffice wherein he argued that

> "there is certainly no teaching or suggestion in the Katzin patent of an arrangement in which *both* the length of succes-sive dipoles *and* the spacing between said dipoles vary in a manner *such that the ratio of the length of adjacent dipoles is a constant which is also equal to the ratio of the spacings between adjacent dipoles.* Unless both of these conditions are met the antenna does not have the remarkably wide band paths, the high gain and the directivity exhibited by the an-tennas of the invention." (Emphasis in the original.)

ubsequently, original claims 1-8 were allowed by examiners H. K. aalbach and Eli Lieberman as were 7 additional claims added as result of an interference proceeding and further amendments by he applicant. It appears, thus, that the above argument in regard o the constant proportional relationship of the lengths and spac-gs of the elements and the importance of such relationship con-inced the Patent Office that the Isbell disclosure was patentable. owever, there is nothing in the file wrapper to indicate that, in uling on the patentability of the Isbell patent, the patent exam-ers considered the published work of DuHamel and Ore, the rmula set out therein, or the log periodic theory of antenna de-gn all of which was a part of the prior art at the time of the pplication. Reference was made thereto in the interference pro-edings as indicated in PX-68.

F.2d at 29. The Court, upon full consideration of the record herein, finds that the disclosure of Isbell's Patent No. 3,210,767 is lacking in the prerequisite nonobviousness and is, therefore, invalid.

Inasmuch as an invalid patent cannot be infringed Imperial Stone Cutters, Inc. v. Schwartz, supra, 370 F.2d at 429; Kell-Dot Indus., Inc. v. Graves, supra, 361 F.2d at 28, the question of infringement is rendered moot and is, therefore, not decided by this Court.

The foregoing shall constitute the findings of fact and conclusions of law pursuant to Fed.R.Civ.P. 52(a).

It is ordered that judgment will be entered for the defendant with costs, exclusive of attorney's fees, taxed to the plaintiff.

APPENDIX A

PLAINTIFF'S EXHIBIT 31

Oct. 5, 1965 D. E. ISBELL 3,210,767

FREQUENCY INDEPENDENT UNIDIRECTIONAL ANTENNAS

Filed May 3, 1960 2 Sheets-Sheet 1

Fig. 1

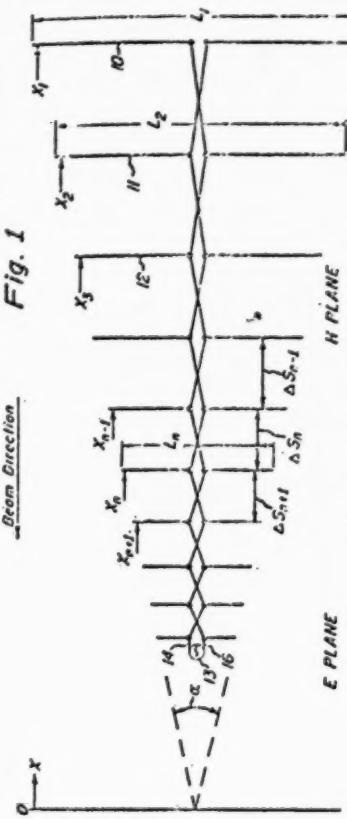


Fig. 4

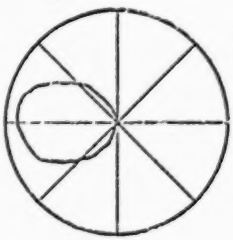
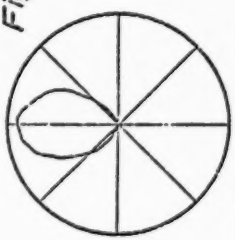


Fig. 3



INVENTOR.
Dwight E. Isbell

BY

Merriam, Smith & Marshall
ATTORNEYS

PLAINTIFFS
EXHIBIT 31
No. 3-695-D Civil
1967

Oct. 5, 1965 D. E. ISBELL 3,210,767

FREQUENCY INDEPENDENT UNIDIRECTIONAL ANTENNAS

Filed May 3, 1960 2 Sheets-Sheet 2

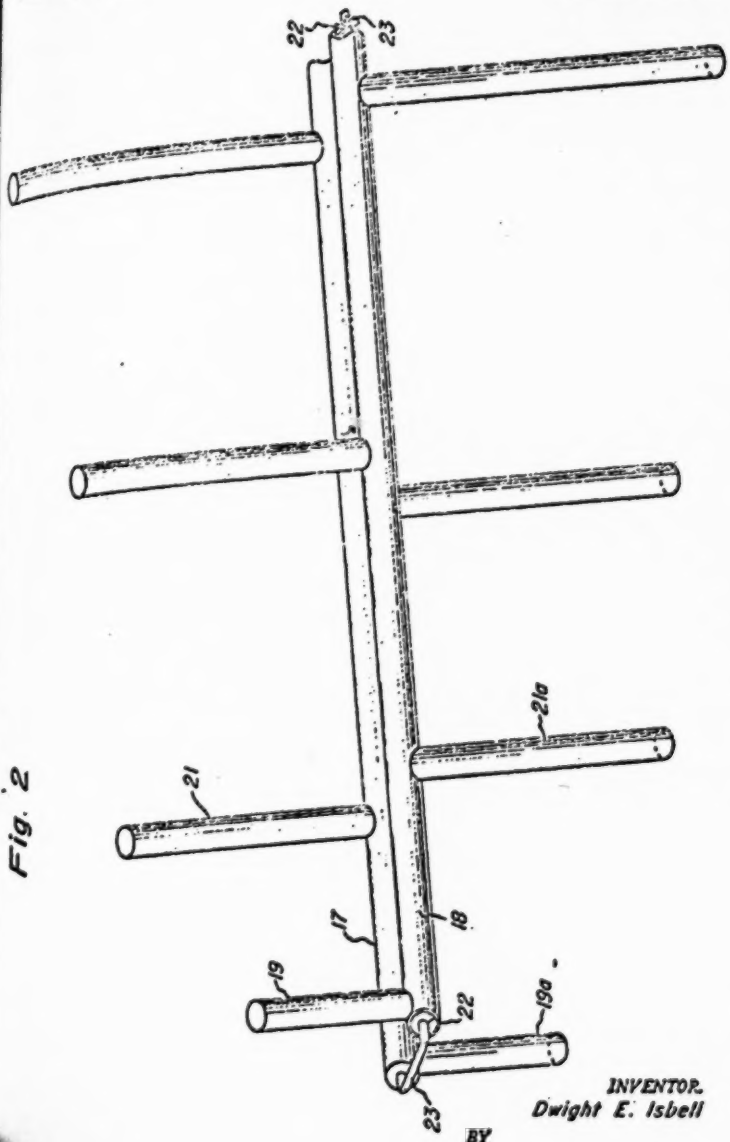


Fig. 2

INVENTOR.
Dwight E. Isbell

BY

Merriam, Smith & Marshall
ATTORNEYS

United States Patent Office

3,210,767

Patented Oct. 5, 1965

3,210,767

FREQUENCY INDEPENDENT UNIDIRECTIONAL ANTENNAS

Wright E. Hoell, Seattle, Wash., assignor to The University of Illinois Foundation, a non-profit corporation of Illinois

Filed May 3, 1960, Ser. No. 26,589

15 Claims. (Cl. 343—792.5)

This invention relates to antennas, and more particularly, it relates to antennas having unidirectional radiation patterns that are essentially independent of frequency over wide bandwidths.

The antennas of the invention are coplanar dipole arrays consisting of a number of dipoles arranged in side-by-side relationship in a plane, the length and the spacing between successive dipoles varying according to a definite mathematical formula, each of the dipoles being fed by a common feeder which introduces a phase reversal of 180° between connections to successive dipoles. The antennas of the invention provide unidirectional radiation patterns of constant beamwidth and nearly constant input impedances over any desired bandwidth.

The invention will be better understood from the following detailed description thereof taken in conjunction with the accompanying drawing, in which:

FIGURE 1 is a schematic plan view of an antenna made in accordance with the principles of the invention;

FIGURE 2 is an isometric view of a practical antenna embodying the invention; and

FIGURES 3 and 4 are radiation patterns of a typical antenna, in the E plane and H plane, respectively.

Referring to FIGURE 1, it will be seen that the antenna of the invention was composed of a plurality of dipoles 10, 11, 12, etc., which are coplanar and in parallel side-by-side relationship. It will be noted that the lengths of the successive dipoles and the spacing between these dipoles is such that the ends of the dipoles fall on a pair of straight lines which intersect and form an angle a. In the preferred embodiment the antenna is symmetrical about a line passing through the midpoints of the dipoles, as shown.

The antenna is fed at its narrow end from a conventional source of energy, depicted in FIGURE 1 by alternator 13, by means of a balanced feeder line consisting of conductors 14 and 16. It will be seen that the feeder wires 14 and 16 are alternated between connections to successive dipoles, thereby producing a phase reversal between such connections.

The lengths of the dipoles and the spacing between dipoles are related by a constant scale factor τ defined by the following equations:

$$\tau = \frac{L_{(n+1)}}{L_n} = \frac{\Delta S_{(n+1)}}{\Delta S_n}$$

where τ is a constant having a value less than 1, L_n is the length of any intermediate dipole in the array, $L_{(n+1)}$ is the length of the adjacent smaller dipole, ΔS_n is the spacing between the dipole having the length L_n and the adjacent larger dipole, and $\Delta S_{(n+1)}$ is the spacing between the dipole having the length L_n and the adjacent smaller dipole.

It will be seen from the geometry of the antennas, as shown above, that the distance from the base line 0 at the apex of the angle a to the dipoles forming the array is defined by the equation:

$$\tau = \frac{X_{(n+1)}}{X_n}$$

where X_n is the distance from the base line 0 to the dipole having the length L_n, $X_{(n+1)}$ is the corresponding distance

from the base line to the adjacent smaller dipole, and τ has the significance previously given.

The radiation pattern of the antennas of the invention, having the geometrical relationship among the several parts as defined above, is unidirectional in the negative X direction, i.e., extending to the left from the narrow end of the antenna of FIGURE 1.

The construction of an actual antenna made in accordance with the invention is shown in FIGURE 2. In this antenna the balanced line consists of two closely-spaced and parallel electrically conducting small diameter tubes 17 and 18 to which are attached the dipoles, each of which consists of two individual dipole elements, e.g., 19 and 19a, 21 and 21a, etc. It will be noted that each of the two elements making up one dipole is connected to a different one of said conductors 17 and 18, in a direction perpendicular to the plane determined by said conductors 17 and 18. Moreover, considering either one of the conductors 17 and 18, consecutive dipole elements along the length thereof extend in opposite directions. It will be seen that this construction has the effect of alternating the phase of the connection between successive dipoles, as depicted schematically in FIGURE 1. Although the dipoles of FIGURE 2 are not precisely coplanar, differing therefrom by the distance between the parallel conductors, in practice this distance is very small so that the dipole elements are substantially coplanar and the advantages of the invention are maintained. The antenna of FIGURE 2 may be conveniently fed by means of a coaxial cable 22 positioned within conductor 18, the central conductor 23 thereof extending to and making electrical connection with conductor 17 as shown.

As an example of the invention, an antenna of the type shown in FIGURE 2 was constructed using 0.125 inch diameter tubing for the balanced line and 0.050 inch diameter wire for the elements. The elements were attached to the feeder line with soft solder, and the array was fed with miniature coaxial cable inserted through one of the balanced line conductors. The antenna was defined by the parameters τ=0.95 and a=20°. The antenna had a total of 15 dipoles, with the longest dipole element being 2½" long, while the shortest element was one-half of this length, or 1¼". The array was 7½" long.

Typical radiation patterns for the above-described antenna in the E plane and the H plane are shown in FIGURES 3 and 4, respectively. These patterns were found to remain essentially constant over the band of about 1100 to 1800 mc./sec. The minimum front-to-back ratio over this band was 17 db and the directivity over the range from about 1130 to 1750 mc./sec. was better than 9 db over isotropic.

The performance of the above-described antenna clearly indicates that the antennas of the invention provide excellent rotatable beams for use particularly in the HF to UHF spectrum. In comparison to the well-known parasitic types of antennas which bear some resemblance to those of the invention, such as the Yagi array, the antennas of the invention provide a much wider bandwidth with essentially comparable directivity. Advantageously, however, the antennas of the invention need no adjusting for their performance over a wide bandwidth, compared to the parasitic types which must be adjusted by cut-and-try procedures for each frequency. Further experimental work with other antennas similar to that described above has indicated that the preferred values for the parameters which define the antennas of the invention include a range of values for angle a between about 20° and 100°, with τ having a value between about 0.8 and about 0.95. When these parameters have values within the preferred ranges the antennas were

...und to have essentially frequency independent performance over any desired bandwidth. The upper and lower limits of the bandwidths may be adjusted as desired by fixing the lengths of the longest dipole and the shortest dipole, respectively. It has been determined experimentally that the longest dipole element should be approximately 0.47 wavelength long at the lower limit and the shortest element should be about 0.38 wavelength long at the upper limit. Moreover, in order to provide suitable front-to-back ratio at the low frequency limit, there should be at least 3 dipoles in the array and preferably about 10 to 20 dipoles.

The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom, as modifications will be obvious to those skilled in the art.

What is claimed is:

1. A broadband unidirectional antenna comprising an array of substantially coplanar and parallel dipoles of progressively increasing length and spacing in side-by-side relationship, the ratio of the lengths of any two adjacent dipoles being given by the formula

$$\frac{L_{n+1}}{L_n} = r$$

where L_n is the length of any intermediate dipole in the array, L_{n+1} is the length of the adjacent smaller dipole and r is a constant having a value less than 1, the spacing between said dipoles being given by the formula

$$\frac{\Delta S_{n+1}}{\Delta S_n} = r$$

where ΔS_n is the spacing between the dipole having the length L_n and the adjacent larger dipole, ΔS_{n+1} is the spacing between the dipole having the length L_n and the adjacent smaller dipole, and r has the significance previously assigned, said dipoles being fed in series by a common feeder which alternates in phase between successive dipoles.

2. The array of claim 1 which is symmetrical about a plane passing through the midpoint of each dipole in the array.

3. A broadband unidirectional antenna comprising an array of a plurality of substantially coplanar and parallel dipoles of progressively increasing length in side-by-side relationship, the ends of said dipoles falling on a V-shaped line forming an angle α at its vertex, the ratio of the lengths of any pair of adjacent dipoles being given by the formula

$$\frac{L_{n+1}}{L_n} = r$$

where L_n is the length of the longer dipole of the pair, L_{n+1} is the length of the shorter dipole, and r is a constant having a value less than 1, the dipoles in said array being fed in series by a common feeder which alternates 180° in phase between successive dipoles.

4. The antenna of claim 3 in which the angle α has a value between about 20° and 100° and the constant r has a value between about 0.8 and 0.95.

5. The antenna of claim 3 in which said feeder is a balanced line which twists 180° between the connections to successive dipoles.

6. A broadband unidirectional antenna comprising a balanced feeder line consisting of two closely spaced, straight and parallel conductors, a plurality of dipoles each consisting of two dipole elements, one of which elements is connected to one of said conductors, the other element being connected directly opposite the first to the other of said conductors, the elements of any dipole extending in opposite directions perpendicular to a plane determined by said conductors, consecutive dipole elements on each of said conductors extending in opposite directions, the ratio of the lengths of the elements in any two adjacent dipoles being given by the formula

$$\frac{l_{n+1}}{l_n} = r$$

where l_n is the length of an element of any dipole in the antenna, l_{n+1} is the length of an element in the adjacent smaller dipole and r is a constant having a value less than 1, the spacing between said dipoles being given by the formula

$$\frac{\Delta S_{n+1}}{\Delta S_n} = r$$

where ΔS_n is the spacing between the dipole having the element length l_n and the adjacent larger dipole, ΔS_{n+1} is the spacing between the dipole having the element length l_n and the adjacent smaller dipole, and r has the significance previously assigned.

7. The antenna of claim 6 wherein r has a value of about 0.8 to 0.95.

8. The antenna of claim 6 wherein said feeder line conductors are tubular.

9. An aerial system including at least one set of parallel dipoles spaced along and substantially perpendicular to the longitudinal axis of a two-conductor balanced feeder to which the halves of the dipoles are connected at their inner ends, said dipoles being of different electrical lengths increasing substantially logarithmically from the connected end of the feeder to the other end and the dipole feeder connections being crossed over one another between adjacent dipoles, the spacings between which also increase substantially logarithmically from said connected end to the other end.

10. An antenna system for wide-band use comprising a plurality of substantially parallel conducting dipole elements arranged in substantially collinear pairs, the opposite dipole elements of each pair constituting dipole halves, a two-conductor balanced feeder having one conductor connected to each of said elements at substantially the inner end thereof, each of said dipole halves in a pair being connected to a different feeder conductor, adjacent dipole elements being reversely connected to different conductors of the feeder, said dipole elements being selectively spaced along and substantially perpendicular to said feeder, the elements of each pair being of substantially equal length, adjacent dipole elements of different pairs differing in length with respect to each other by a substantially constant scale factor, the selective spacings between adjacent dipoles generally decreasing from one end of the feeder to the other with the greatest spacing being between the longest dipoles, and means to connect the feeder to an external circuit at substantially the location of the smallest of the dipole elements.

11. An antenna system for wide-band use comprising a plurality of substantially parallel conducting dipole elements arranged in substantially collinear pairs, the opposite dipole elements of each pair constituting dipole halves, a two-conductor balanced feeder having one conductor connected to each of said elements at substantially the inner end thereof, each of said dipole halves in a pair being connected to a different feeder conductor, adjacent dipole elements being reversely connected to different conductors of the feeder, said dipole elements being selectively spaced along and substantially perpendicular to said feeder, the elements of each pair being of substantially equal length, adjacent dipole elements of different pairs differing in length with respect to each other by a substantially constant scale factor, the selective spacings between the dipoles along the feeder differing from each other also by a substantially constant scale factor, the greatest spacing being between the longest dipoles, and means to connect the feeder to an external circuit at substantially the location of the smallest of the dipoles.

12. The aerial system of claim 11 in which said scale

66a

ctive have values within the range from about 0.8 to bout 0.95.

13. An antenna system for wide-band use comprising n array of at least three linear substantially parallel onducting dipoles, each dipole being composed of two pposite substantially collinear conducting elements, a o-conductor balanced feeder having one conductor conected to each of said elements at substantially the inner nd thereof, adjacent parallel dipole elements being reectively connected to a different conductor of the feeder, he two elements of each dipole being of lengths substantially equal and successive elements being of lengths which differ from one dipole to the next by a substantially constant scale factor within the range from about 0.8 to about 0.95, the dipoles being spaced from each other in a generally decreasing manner in the direction of decreasing element length, and means to connect the feeder conductors to an external circuit at substantially the location of the smallest dipole elements.

14. An antenna system for wide-band use comprising a minimum of three pairs of linear substantially parallel conducting elements arranged substantially coplanarly, each pair being substantially collinear and comprising the halves of a dipole, a two-conductor feeder connected to the inner ends of said collinear pairs of elements, adjacent parallel elements being connected to different conductors of the feeder so that the halves of the dipoles connected to different conductors of the feeder and adjacent dipoles are reversely connected, the halves of each dipole being substantially the same length, adjacent dipole elements being selectively spaced from each other along the feeder, the length of the successive dipole elements and the feeder decreasing in accordance with a substantially constant scale factor, each dipole and the feeder between it and the adjacent dipole constituting a cell, the combination of the several cells commencing from the point of connection of one dipole and the feeder to the outer ends of the next smaller adjacent dipole also decreasing from one cell to the next in the direction of decreasing scale length according to a substantially constant scale factor so that the combination of cells provides a substantially uniform wide-band response, and means to connect an external circuit to the feeder elements at substantially the location of the shortest of the dipoles.

15. An antenna system for wide-band use comprising a minimum of three pairs of substantially parallel and coplanar linear conducting elements arranged in substantially collinear pairs, each pair of elements comprising the halves of a dipole, a two-conductor feeder, one conductor of which is connected to each of said elements substantially at the inner end thereof, adjacent parallel elements being connected to different conductors of the feeder so that the halves of the dipoles connect to different conductors of the feeder and adjacent dipoles are reversely connected, the halves of each dipole being substantially the same length, adjacent dipole elements being selectively spaced from each other along the feeder, the lengths of the elements decreasing from one end of the feeder to the other substantially in accordance with a substantially constant scale factor within the range from about 0.8 to 0.95, each dipole and the feeder between it and the adjacent dipole constituting a cell, the cell dimension from the inner end of one dipole to the outer end of the next smaller adjacent dipole also generally decreasing from one cell to the next in the direction from the longer to the shorter dipoles so that the combination of cells provides a substantially uniform wide-band response, and means to connect an external circuit to the feeder elements at substantially the location of the shortest of the dipoles.

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APPENDIX B

March 5, 1940. M. KATZIN 2,192,532

DIRECTIVE ANTENNA

Filed Feb. 5, 1938

Fig. 1

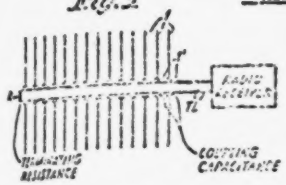


Fig. 2

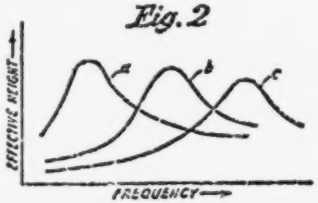


Fig. 3a

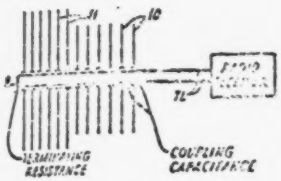


Fig. 3b

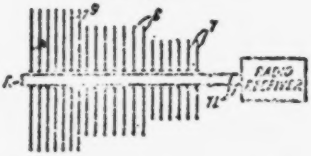


Fig. 3c

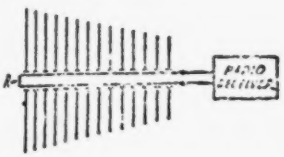


Fig. 4

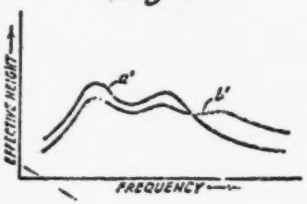
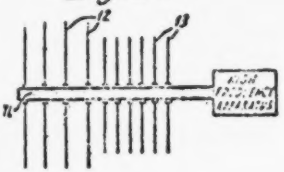


Fig. 3d



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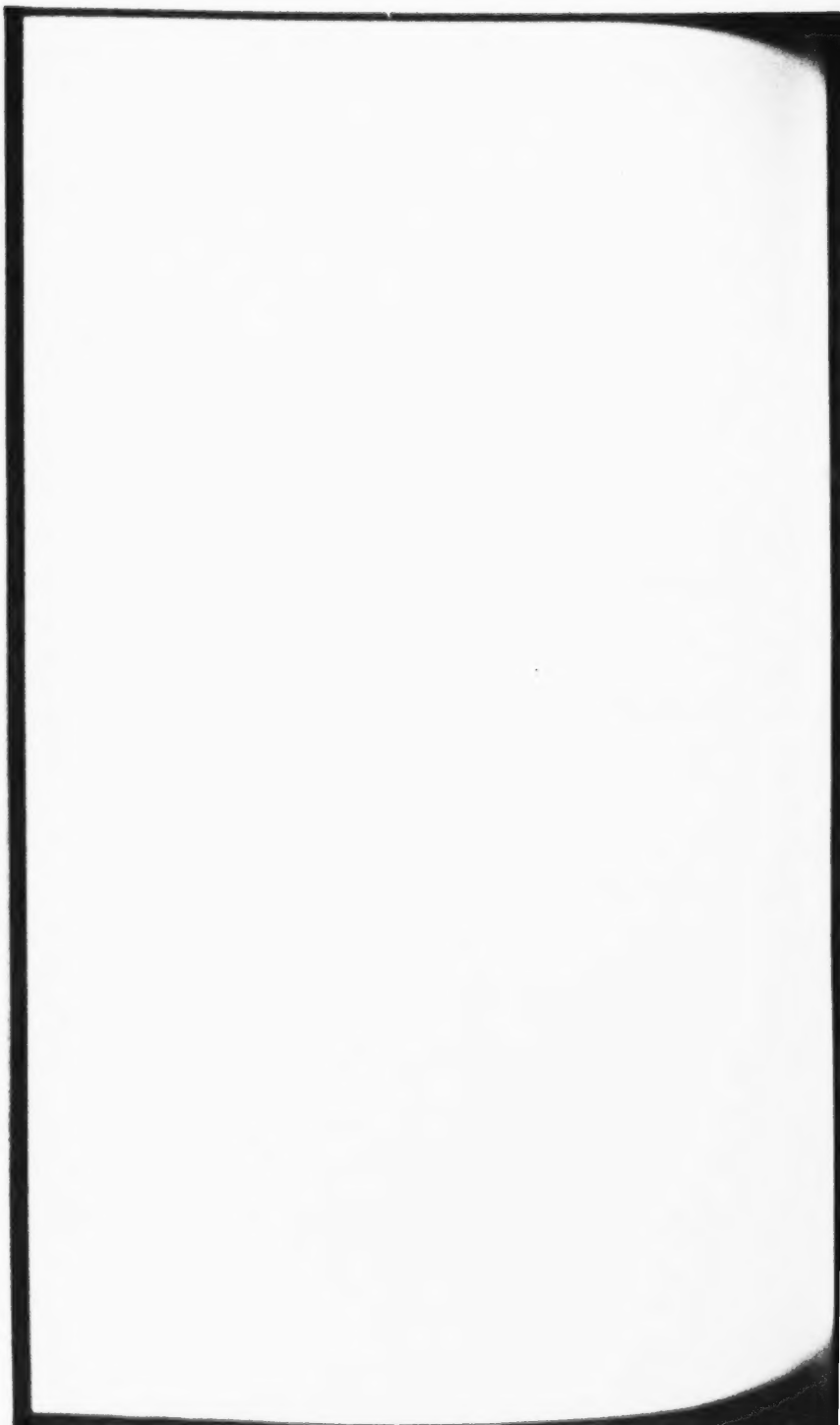
BY H. B. Brown

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APPENDIX C

CHANNEL MASTER
"K.O"-model 1023



APPENDIX D

June 26, 1934. N. KOOMANS 1,964,189

DIRECTIVE ANTENNA

Filed Sept. 11, 1928

Fig. 1.

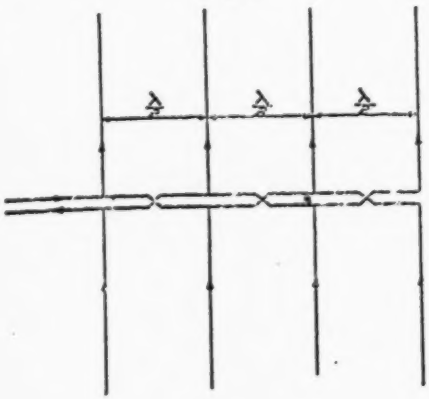
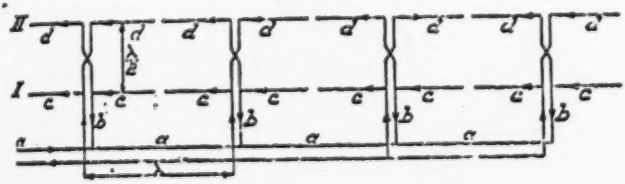


Fig. 2.



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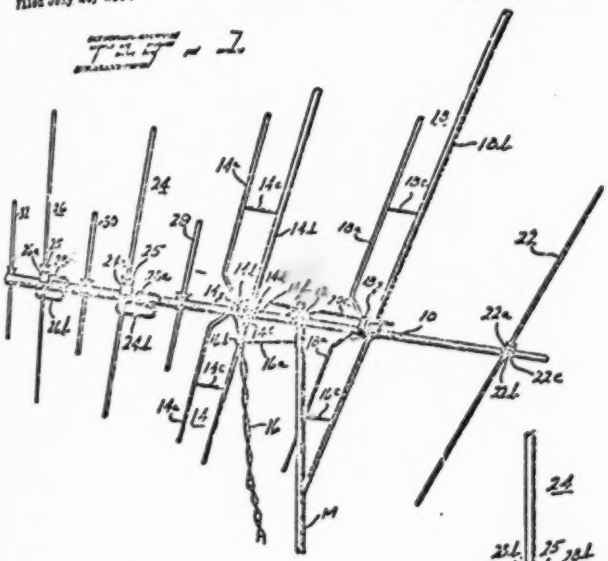
APPENDIX B

Jan. 18, 1955 J. R. WINEGARD 2,700,105

T. V. ANTENNA ARRAY

Filed July 26, 1954 2 Sheets-Sheet 1

Fig. 1.



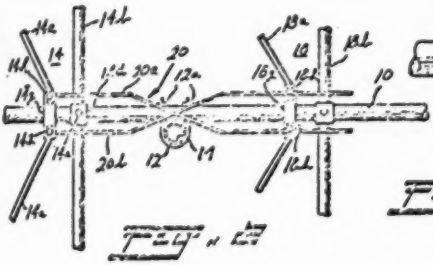


Fig. 3

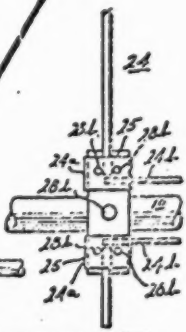


Fig. 2

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APPENDIX F

Jan. 18, 1938. E. L. C. WHITE ET AL 2,105,569

DIRECTIONAL WIRELESS AERIAL SYSTEM

Filed April 6, 1936

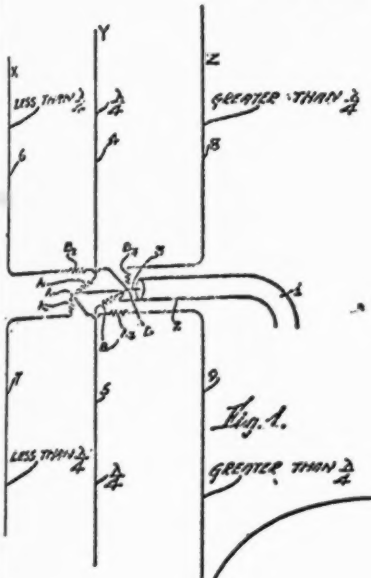


Fig. 1.

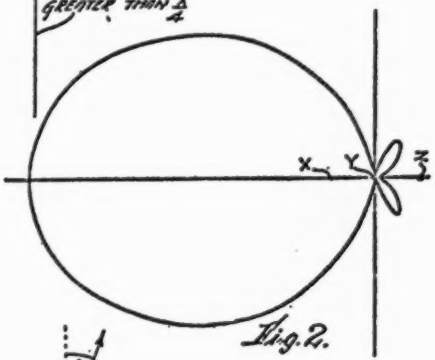


Fig. 2.

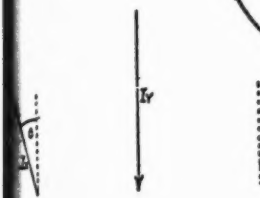


Fig. 3.

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